Allen-Bradley

Kinetix 6000 Multi-axis Servo Drive

Catalog Numbers
2094-AC05-MP5, 2094-AC05-M01, 2094-AC09-M02, 2094-AC16-M03, 2094-AC32-M05, 2094-BC01-MP5, 2094-BC01-M01, 2094-BC02-M02, 2094-BC04-M03, 2094-BC07-M05

2094-AC05-MP5-S, 2094-AC05-M01-S, 2094-AC09-M02-S, 2094-AC16-M03 -S, 2094-AC32-M05-S, 2094-BC01-MP5-S, 2094-BC01-M01-S, 2094-BC02-M02-S, 2094-BC04-M03-S, 2094-BC07-M05-S

2094-AMP5, 2094-AM01, 2094-AM02, 2094-AM03, 2094-AM05, 2094-BMP5, 2094-BM01, 2094-BM02, 2094-BM03, 2094-BM05

2094-AMP5-S, 2094-AM01-S, 2094-AM02-S, 2094-AM03-S, 2094-AM05-S, 2094-BMP5-S, 2094-BM01-S, 2094-BM02-S, 2094-BM03-S, 2094-BM05-S

2094-BSP2

User Manual

Rockwell Automation

Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls (publication SGI-1.1 available from your local Rockwell Automation sales office or online at http://literature.rockwellautomation.com) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

WARNING 	Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.
ATTENTION 	Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence
SHOCK HAZARD 	Labels may be located on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
BURN HAZARD 	Labels may be located on or inside the equipment, for example, a drive or motor, to alert people that surfaces may be at dangerous temperatures.

Chapter 5

Connecting the Kinetix 6000 Drive System

Appendix A

Specifications and Dimensions

Appendix B

Interconnect Diagrams

Appendix C

Upgrading Firmware

Appendix D

DC Common Bus Applications

Appendix E

Integrating Resistive Brake Modules with Kinetix 6000 Drives

Read this preface to familiarize yourself with the rest of the manual.

About This Publication

This manual provides detailed installation instructions for mounting, wiring, and troubleshooting your Kinetix 6000 drive, and system integration for your drive/motor combination with a Logix controller.

Who Should Use this Manual

This manual is intended for engineers or technicians directly involved in the installation and wiring of the Kinetix 6000 drive, and programmers directly involved in the operation, field maintenance, and integration of the Kinetix 6000 drive with a SERCOS interface module.

If you do not have a basic understanding of the Kinetix 6000 drive, contact your local Rockwell Automation sales representative before using this product, for information on available training courses.

Conventions Used in This Manual

The conventions starting below are used throughout this manual.

- Bulleted lists such as this one provide information, not procedural steps
- Numbered lists provide sequential steps or hierarchical information
- Acronyms for the Kinetix 6000 drive components, shown in the table below, are used throughout this manual.

Kinetix 6000 Component	Catalog Numbers	Acronym
Integrated Axis Module	2094-*x*C*xx*-M*xx*	IAM
Axis Module	2094-*x*M*xx*	AM
Shunt Module	2094-BSP2	SM
Power Rail	2094-PR*x*	PR
Power Rail (slim)	2094-PRS*x*	PRS
Power Rail Slot Filler	2094-PRF	PRF
Line Interface Module	2094-*x*L*xx* and -*x*L*xx*S-*xx*	LIM
Resistive Brake Module	2090-XB*xx-xx*	RBM

Additional Resources

The following documents contain additional information concerning related Allen-Bradley products.

For	Read This Document	Publication Number
Information on the installation of your Bulletin 2094 Power Rail	Kinetix 6000 Power Rail Installation Instructions	2094-IN003
Information on the installation and troubleshooting of your Bulletin 2094 Line Interface Module (LIM)	Line Interface Module Installation Instructions	2094-IN005
Information on the installation of Bulletin 2094 Mounting Brackets	2094 Mounting Bracket Installation Instructions	2094-IN008
Information on the installation and wiring of Bulletin 2090 Resistive Brake Modules	Resistive Brake Module Installation Instructions	2090-IN009
Information on proper handling, installing, testing, and troubleshooting fiber-optic cables	Fiber-optic Cable Installation and Handling Instructions	2090-IN010
Information on installing, configuring, and how to calculate the data needed to correctly select a 1336 dynamic brake	1336 Dynamic Braking Installation Instructions	1336-5.64
Information, examples, and techniques designed to minimize system failures caused by electrical noise	System Design for Control of Electrical Noise Reference Manual	GMC-RM001
	EMC Noise Management DVD	GMC-SP001
Information on wiring and troubleshooting your Kinetix 6000 safety drive	Kinetix Safe-off Feature Safety Reference Manual	GMC-RM002
Specifications, motor/servo-drive system combinations, and accessories for Kinetix motion control products	Kinetix Motion Control Selection Guide	GMC-SG001
Drive and motor sizing with application analysis software	Motion Analyzer CD, v4.2 or later	PST-SG003
Information on configuring and troubleshooting your ControlLogix and CompactLogix SERCOS interface modules	Motion Modules in Logix5000 Control Systems User Manual	LOGIX-UM002
Information on configuring and troubleshooting your SoftLogix PCI card	SoftLogix Motion Card Setup and Configuration Manual	1784-UM003
Information on installing, configuring, programming, and operating a ControlLogix system	ControlLogix Controllers User Manual	1756-UM001
More detailed information on the use of ControlLogix motion features and application examples	ControlLogix Motion Module Programming Manual	1756-RM086
The instructions needed to program a motion application	Logix5000 Controllers Motion Instructions Reference Manual	1756-RM007
For ControlFLASH information not specific to any drive family	ControlFLASH Firmware Upgrade Kit User Manual	1756-6.5.6
Online product selection and system configuration tools, including AutoCAD (DXF) drawings	Rockwell Automation Configuration and Selection Tools website	http://www.ab.com/e-tools
For declarations of conformity (DoC) currently available from Rockwell Automation	Rockwell Automation Product Certification website	http://www.rockwellautomation.com/products/certification
An article on wire sizes and types for grounding electrical equipment	National Electrical Code	Published by the National Fire Protection Association of Boston, MA.
A glossary of industrial automation terms and abbreviations	Rockwell Automation Industrial Automation Glossary	AG-7.1

You can view or download publications at http://literature.rockwellautomation.com. To order paper copies of technical documentation, contact your local Rockwell Automation distributor or sales representative.

Start

Introduction

Use this chapter to become familiar with the Kinetix 6000 drive components. This chapter also reviews design and installation requirements for Kinetix 6000 drive systems.

About the Kinetix 6000 Drive System

The Kinetix 6000 multi-axis servo drive is designed to provide a Kinetix Integrated Motion solution for applications with output power requirements between 3 and 45 kW (4 and 49 A).

Kinetix 6000 Drive System Overview

Kinetix 6000 Component	Catalog Numbers	Description
Integrated Axis Module	2094-*xCxx*-M*xx*-S [1]	Integrated Axis Module (IAM), with safe-off feature available with 230V and 460V ac input power and contains an inverter and converter.
	2094-*xCxx*-M*xx*	Integrated Axis Module (IAM), available with 230V and 460V ac input power and contains an inverter and converter.
Axis Module	2094-BM*xx*-S [1]	Axis Module (AM), with safe-off feature is a shared dc bus inverter (230V and 460V). The AM must be used with an IAM.
	2094-*x*M*xx*	Axis Module (AM), is a shared dc bus inverter (230V and 460V). The AM must be used with an IAM.
Shunt Module	2094-BSP2	Shunt Module (SM), This module mounts to the power rail and provides additional shunting capability in regenerative applications.
Power Rail	2094-PRS*x* 2094-PR*x*	Power Rail (PR) consists of copper bus bars and a circuit board with connectors for each module. The power rail provides power and control signals from the converter section to adjacent inverters. The IAM, AM, SM, and PRF modules mount to the power rail.
Power Rail Slot Filler	2094-PRF	Power Rail Slot Filler (PRF) is used when one or more slots on the power rail are empty after all the power rail components are installed. One PRF module is required for each empty slot.
Logix Controller Platform	1756-M*xx*SE module 1768-M04SE module 1784-PM16SE PCI card	SERCOS interface module/PCI card serves as a link between the ControlLogix/CompactLogix/SoftLogix platform and Kinetix 6000 drive system. The communication link uses the IEC 61491 SErial Real-time COmmunication System (SERCOS) protocol over a fiber-optic cable.
RSLogix 5000 Software	9324-RLD300ENE	RSLogix 5000 provides support for programming, commissioning, and maintaining the Logix family of controllers.
Servo Motors	MP-Series, 1326AB, TL-Series, F- and Y-Series	Compatible servo motors include the MP-Series (Low Inertia, Integrated Gear, Food Grade, and Stainless Steel) 230 and 460V motors; TL-Series motors; 1326AB (M2L/S2L) and 1326AB (resolver) motors; F- and Y-Series motors.
Cables	Motor Power, Feedback, and Brake cables	Motor power, feedback, and brake cables include integral molded, bayonet style, quick connect/quick-release connectors at the motor. Power and brake cables have flying leads on the drive end and straight connectors that connect to servo motors. Standard feedback cables have angled connectors (45°) on the drive end and straight connectors that connect to servo motors. Optional feedback cables have a straight connector on the motor end and flying leads that wire to a low-profile connector kit on the drive end.
	Fiber-optic cables	SERCOS fiber-optic cables are available in enclosure only, PVC, nylon, and glass with connectors at both ends.
AC Line Filters	2090-XXLF-*xxxx*	Bulletin 2090-XXLF-*xxxx* three-phase ac line filters are required to meet CE and available for use in 230V and 460V systems.
Line Interface Module	2094-*xLxx* 2094-*xLxx*S 2094-XL75S-C*x*	Line Interface Module (LIM), contains the circuit breakers, ac line filter (2094-AL09 and -BL02 only), power supplies, and safety contactor required for Kinetix 6000 operation. This module does not mount to the power rail. Individual components can be purchased separately in place of the LIM.
External Shunt Modules	1394-SR*xxxx*	Bulletin 1394 external passive shunt modules can be used when the IAM/AM internal shunt and power rail mounted shunt module (2094-BSP2) capability is exceeded.
	1336-MOD-K*xxxx*	Bulletin 1336 external active shunt modules can be used when the internal shunt resistor (IAM/AM) capability is exceeded.
Resistive Brake Module	2090-XB*xx-xx*	Resistive Brake Module (RBM), includes a safety contactor for use in a control circuit. Contactors and resistors reside in this module such that the motor leads can be disconnected from the drive with the permanent magnet motor brought to an immediate stop. This module does not mount to the power rail.

[1] Refer to the Kinetix Safe-off Feature Safety Reference Manual, publication GMC-RM002, for more information.

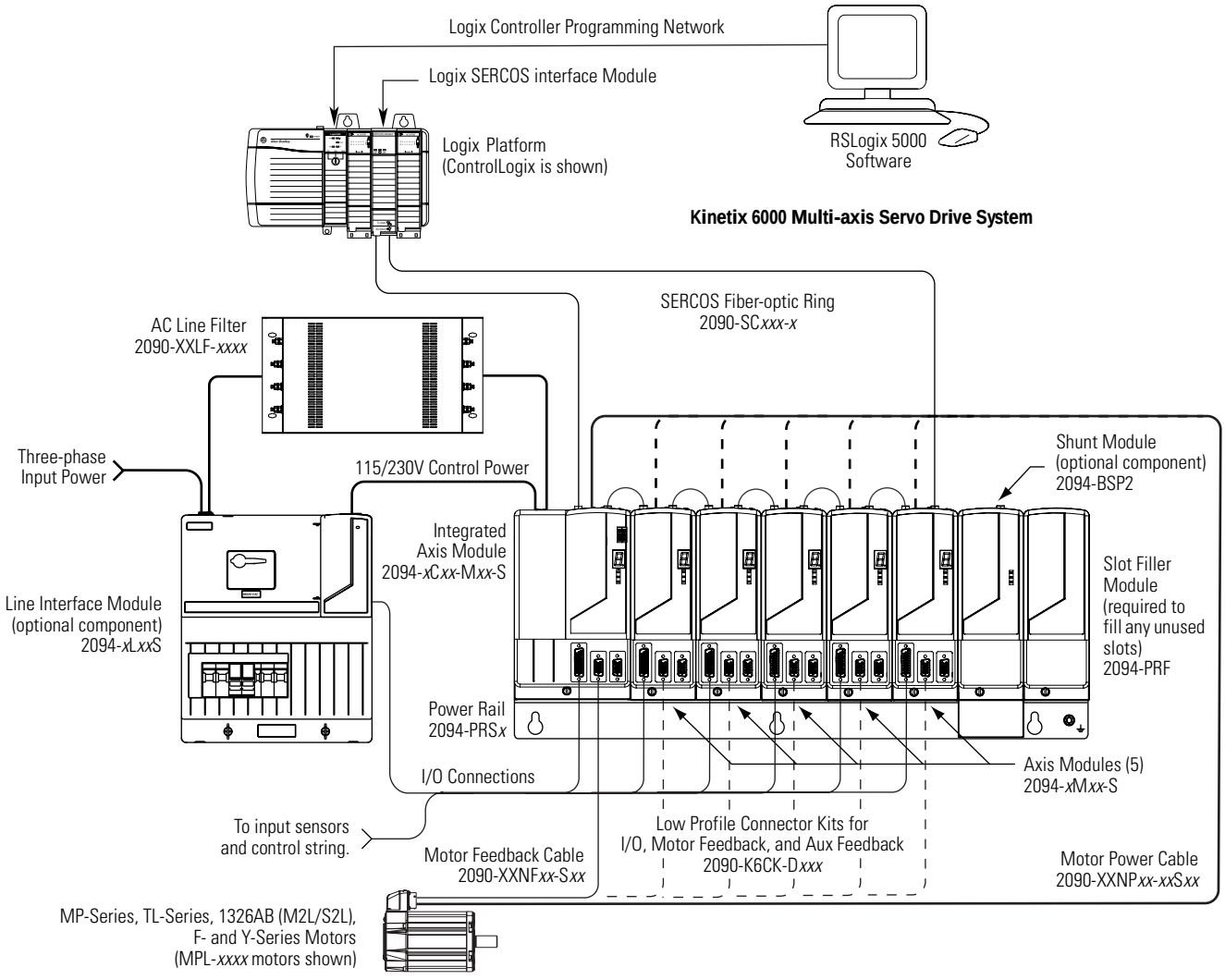
Typical Kinetix 6000 system installations include three-phase ac configurations, with and without the line interface module (LIM), and dc common bus configurations.

SHOCK HAZARD

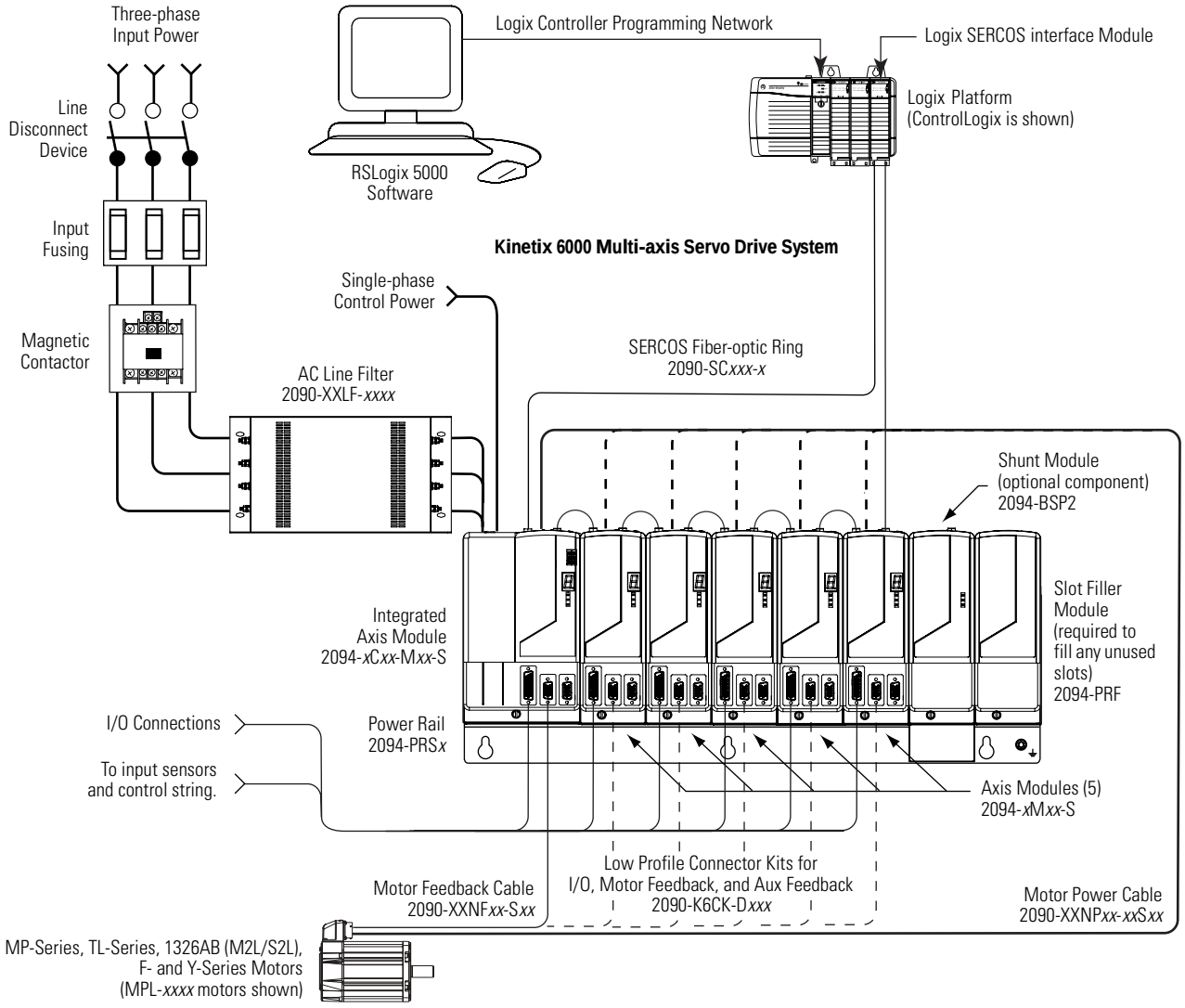
To avoid personal injury due to electrical shock, place a slot filler module (catalog number 2094-PRF) in all empty slots on the power rail.

Any power rail connector without a module installed will disable the Kinetix 6000 three-phase power, however control power is still present.

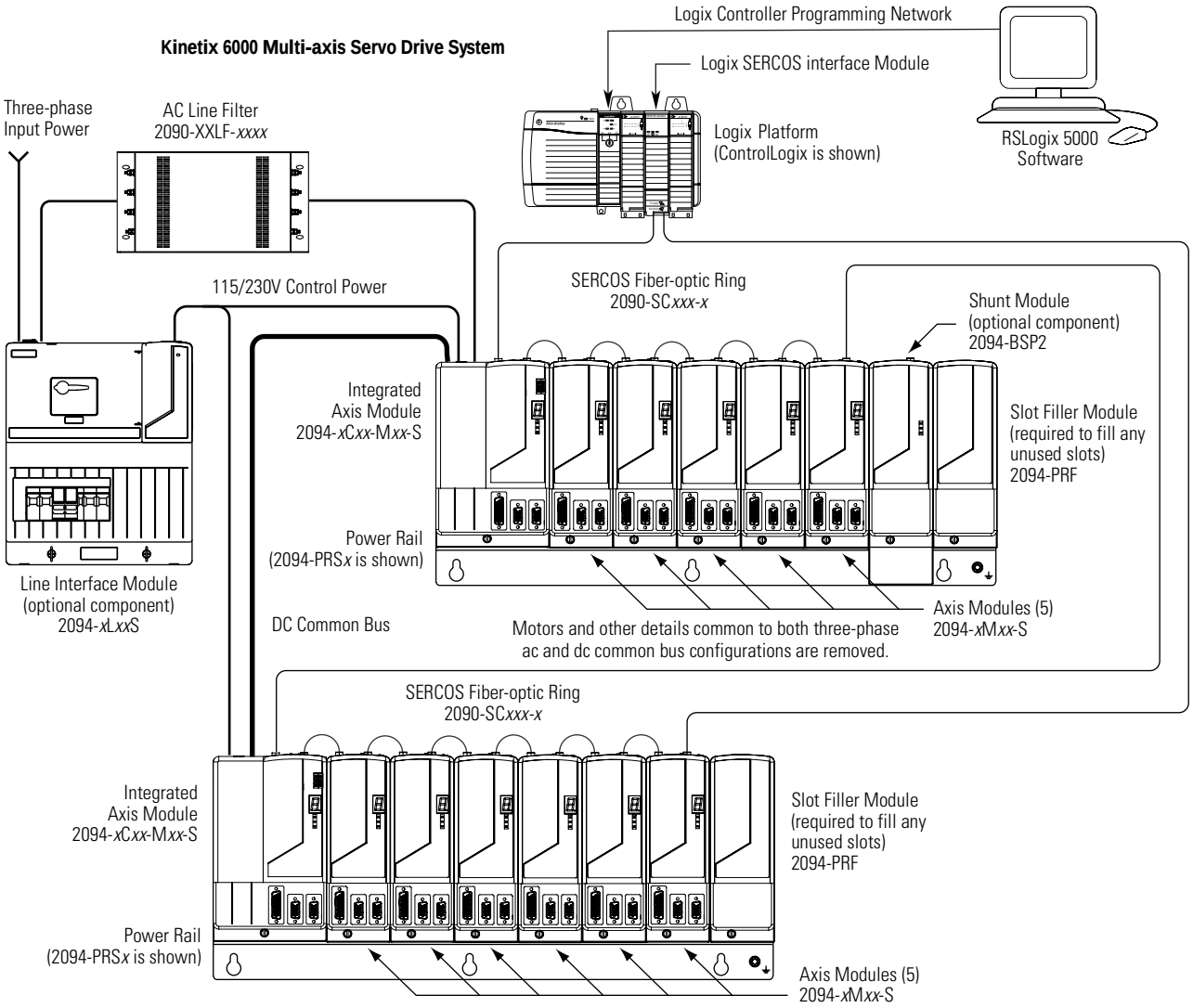
Typical Kinetix 6000 System Installation (with LIM)



Typical Kinetix 6000 System Installation (without LIM)



Typical DC Common Bus System Installation



In the example above, the leader IAM is connected to the follower IAM via the dc common bus. When planning your panel layout, you must calculate the total bus capacitance of your dc common bus system to ensure that the leader IAM is sized sufficiently to pre-charge the entire system.

Refer to Appendix D, beginning on page 231, for more information.

IMPORTANT If total bus capacitance of your system exceeds the leader IAM pre-charge rating and input power is applied, the IAM seven-segment LED indicator will display error code E90 (pre-charge timeout fault). To correct this condition, you must replace the leader IAM with a larger module or decrease the total bus capacitance by removing axis modules.

Catalog Number Explanation

Kinetix 6000 drive catalog numbers and descriptions are listed in the table below.

Kinetix 6000 Drive Catalog Numbers

Integrated Axis Modules (230V	Catalog Number (with safe-off feature)	Catalog Number (without safe-off feature)
Kinetix 6000, IAM, 230V, 3 kW converter, 5 A inverter	2094-AC05-MP5-S	2094-AC05-MP5
Kinetix 6000, IAM, 230V, 3 kW converter, 9 A inverter	2094-AC05-M01-S	2094-AC05-M01
Kinetix 6000, IAM, 230V, 6 kW converter, 15 A inverter	2094-AC09-M02-S	2094-AC09-M02
Kinetix 6000, IAM, 230V, 11 kW converter, 24 A inverter	2094-AC16-M03-S	2094-AC16-M03
Kinetix 6000, IAM, 230V, 23 kW converter, 49 A inverter	2094-AC32-M05-S	2094-AC32-M05
Integrated Axis Modules (460V)		
Kinetix 6000, IAM, 460V, 6 kW converter, 4 A inverter	2094-BC01-MP5-S	2094-BC01-MP5
Kinetix 6000, IAM, 460V, 6 kW converter, 9 A inverter	2094-BC01-M01-S	2094-BC01-M01
Kinetix 6000, IAM, 460V, 15 kW converter, 15 A inverter	2094-BC02-M02-S	2094-BC02-M02
Kinetix 6000, IAM, 460V, 28 kW converter, 30 A inverter	2094-BC04-M03-S	2094-BC04-M03
Kinetix 6000, IAM, 460V, 45 kW converter, 49 A inverter	2094-BC07-M05-S	2094-BC07-M05
Axis Modules (230V)		
Kinetix 6000, AM, 230V, 5 A	2094-AMP5-S	2094-AMP5
Kinetix 6000, AM, 230V, 9 A	2094-AM01-S	2094-AM01
Kinetix 6000, AM, 230V, 15 A	2094-AM02-S	2094-AM02
Kinetix 6000, AM, 230V, 24 A	2094-AM03-S	2094-AM03
Kinetix 6000, AM, 230V, 49 A	2094-AM05-S	2094-AM05
Axis Modules (460V)		
Kinetix 6000, AM, 460V, 4 A	2094-BMP5-S	2094-BMP5
Kinetix 6000, AM, 460V, 9 A	2094-BM01-S	2094-BM01
Kinetix 6000, AM, 460V, 15 A	2094-BM02-S	2094-BM02
Kinetix 6000, AM, 460V, 30 A	2094-BM03-S	2094-BM03
Kinetix 6000, AM, 460V, 49 A	2094-BM05-S	2094-BM05
Shunt Module		
Kinetix 6000, SM, 230V/460V, 200W	N/A	2094-BSP2

Agency Compliance

If this product is installed within the European Union or EEC regions and has the CE mark, the following regulations apply.

ATTENTION

Meeting CE requires a grounded system, and the method of grounding the ac line filter and drive must match. Failure to do this renders the filter ineffective and may cause damage to the filter.

For grounding examples, refer to Grounded Power Configurations on page 71.

For more information on electrical noise reduction, refer to the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001.

CE Requirements (System without LIM)

To meet CE requirements when your Kinetix 6000 system does not include the line interface module (LIM), the following requirements apply.

- Install an ac line filter (2090-XXLF-*xxxx*) as close to the integrated axis module (IAM) as possible.
- Use 2090 series motor power cables or use connector kits and terminate the cable shields to the chassis clamp provided.
- Combined motor power cable length for all axes on the same dc bus must not exceed 240 m (787 ft) with 460V systems or 160 m (525 ft) with 230V systems. Drive-to-motor power cables must not exceed 90 m (295.5 ft).
- Use 2090 series motor feedback cables or use connector kits and properly terminate the feedback cable shield. Drive-to-motor feedback cables must not exceed 90 m (295.5 ft).
- Install the Kinetix 6000 system inside an enclosure. Run input power wiring in conduit (grounded to the enclosure) outside of the enclosure. Separate signal and power cables.

Refer to Chapter 5, beginning on page 69, for wiring instructions and the Kinetix Motion Control Selection Guide, publication GMC-SG001, for catalog numbers.

CE Requirements (System with LIM)

To meet CE requirements when your Kinetix 6000 system includes the line interface module (LIM), follow all the requirements as stated in CE Requirements (System without LIM) and these additional requirements as they apply to the ac line filter.

- Install the LIM (2094-AL09 or -BL02) as close to the integrated axis module (IAM) as possible.
- Install the LIM (2094-AL*xx*S, -BL*xx*S or -XL75S-C*x*) with line filter (2090-XXLF-*xxxx*) as close to the IAM as possible.

  When the LIM (2094-AL*xx*S, -BL*xx*S or -XL75S-C*x*) supports two IAMs, each IAM requires an ac line filter installed as close to the IAM as possible.

Planning the Kinetix 6000 Drive System Installation

Introduction

This chapter describes system installation guidelines used in preparation for mounting your Kinetix 6000 drive components.

ATTENTION

Plan the installation of your system so that you can perform all cutting, drilling, tapping, and welding with the system removed from the enclosure. Because the system is of the open type construction, be careful to keep any metal debris from falling into it. Metal debris or other foreign matter can become lodged in the circuitry, which can result in damage to components.

System Design Guidelines

Use the information in this section when designing your enclosure and planning to mount your system components on the panel.

For on-line product selection and system configuration tools, including AutoCAD (DXF) drawings of the product, refer to http://www.ab.com/e-tools.

System Mounting Requirements

- In order to comply with UL and CE requirements, the Kinetix 6000 system must be enclosed in a grounded conductive enclosure offering protection as defined in standard EN 60529 (IEC 529) to IP55 such that they are not accessible to an operator or unskilled person. A NEMA 4X enclosure exceeds these requirements providing protection to IP66.
- The panel you install inside the enclosure for mounting your system components must be on a flat, rigid, vertical surface that won't be subjected to shock, vibration, moisture, oil mist, dust, or corrosive vapors.
- Size the drive enclosure so as not to exceed the maximum ambient temperature rating. Consider heat dissipation specifications for all drive components.
- Segregate input power wiring and motor power cables from control wiring and motor feedback cables. Use shielded cable for power wiring and provide a grounded 360° clamp termination.
- Use high-frequency (HF) bonding techniques to connect the modules, enclosure, machine frame, and motor housing, and to provide a low-impedance return path for high-frequency (HF) energy and reduce electrical noise.

  Refer to the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001, to better understand the concept of electrical noise reduction.

Transformer Selection

The integrated axis module (IAM) does not require an isolation transformer for three-phase input power. However, a transformer may be required to match the voltage requirements of the controller to the available service.

To size a transformer for the main ac power inputs, refer to the Circuit Breaker/Fuse Specifications on page 177 and Transformer Specifications for Control Power Input on page 179.

IMPORTANT If using an autotransformer, make sure that the phase to neutral/ground voltages do not exceed the input voltage ratings of the drive.

IMPORTANT Use a form factor of 1.5 for three-phase power (where form factor is used to compensate for transformer, drive module and motor losses, and to account for utilization in the intermittent operating area of the torque speed curve).

Example: Sizing a transformer to the voltage requirements of a 2094-AC05-M01 Integrated Axis Module:
2094-AC05-M01 = 3 kW continuous x 1.5 = 4.5 KVA transformer

Circuit Breaker/Fuse Selection

The Kinetix 6000 system utilizes internal short circuit output protection and is suitable for use on a circuit capable of delivering up to 100,000 amperes, when protected by class CC, J, L, and R fuses. Circuit breakers with adequate widthstand and interrupt ratings, as defined in NEC 2002, article 110.9 and 110.10, are also permitted.

The Bulletin 140M product may be another acceptable means of protection with the Kinetix 6000 system. As with fuses and circuit breakers, you must make sure that the selected components are properly coordinated and meet applicable codes. When applying the 140M product, evaluation of the short circuit available current is critical and must be kept below the short circuit rating of the 140M product. As long as you do this review, and the conditions for use are met, the 140M product is appropriate for use with the Kinetix 6000 system.

The line interface modules (LIM), (models 2094-AL09 and -BL02) contain supplementary protection devices. When these models are used, protection on the line side of the LIM with a maximum let through current of 5000 amperes is required. Fuses must be class J or CC only.

Overcurrent protection must be adequately coordinated per NEC 2002, article 240.

In most cases, fuses selected to match the drive input current rating will meet the NEC requirements and provide the full drive capabilities. Dual element, time delay (slow acting) fuses should be used to avoid nuisance trips during the inrush current of power initialization.

Refer to Circuit Breaker/Fuse Specifications on page 177 for recommended circuit breakers and fuses.

Refer to Power Specifications on page 170 for input current and inrush current specifications for your IAM.

Enclosure Selection

The following example is provided to assist you in sizing an enclosure for your Kinetix 6000 system. The example system consists of the following components:

- 6-axis Kinetix 6000 servo drive system
- Line Interface Module (LIM)
- ControlLogix chassis and modules (controller)

Size the Kinetix 6000 servo drive and LIM and use the results to predict the amount of heat dissipated into the enclosure. You will also need heat dissipation data from other equipment inside the enclosure (such as ControlLogix controller). Once the total amount of heat dissipation (in watts) is known, the minimum enclosure size can be calculated.

Kinetix 6000 System Heat Dissipation Example

Enclosure Component	Description		Loading (1)	Heat Dissipation (1) watts
2094-AC09-M02	Integrated axis module (IAM), 200/230V	6 kW (converter section)	20%	33
		15A (inverter section)	40%	73
2094-AM02	Axis module (AM), 200/230V, 15 A		60%	82
2094-AM02	Axis module (AM), 200/230V, 15 A		60%	82
2094-AM01	Axis module (AM), 200/230V, 9 A		40%	69
2094-AM01	Axis module (AM), 200/230V, 9 A		40%	69
2094-AM01	Axis module (AM), 200/230V, 9 A		20%	62
2094-AL09	Line interface module (LIM), 200/230V, 6 kW, 6 A; 24V dc 3 A		100%	72
2094-PR6	Power rail, 230V, 6 axis		N/A	0
2090-XB33-32	Resistive brake module (RBM), 33 A, 32 Ω		N/A	30
Total Kinetix 6000 system wattage				572

(1) To determine heat dissipation specifications for the Kinetix 6000 components, refer to Power Dissipation Specifications on page 180.

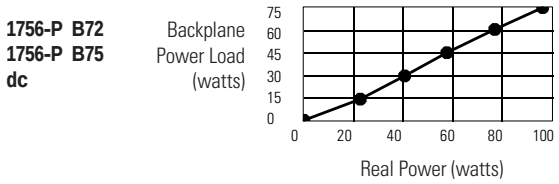
ControlLogix System Heat Dissipation Example

Enclosure Component	Description	Backplane Power Load [1] watts	Heat Dissipation [1] watts
1756-M08SE	8-axis SERCOS interface module	3.2	0
1756-L55M12	5555 ControlLogix processor	4.5	0
1756-IB16D	16 -point input module	0.84	5.8
1756-OB16D	16 -point output module	4.64	3.3
1756-ENBT	Ethernet communications module	4.0	0
Backplane total		17.18 [2]	N/A
1756-PB72	24V dc ControlLogix power supply	N/A	25 [2]
1756-A7	7-slot mounting chassis	N/A	N/A
Total ControlLogix system wattage			34.1

(1) For ControlLogix module specifications, refer to the ControlLogix Selection Guide, publication 1756-SG001.

(2) Real power heat dissipation is determined by applying the backplane power load (17.18W) to the graph below.

ControlLogix Real Power



For backplane power loading requirements of other ControlLogix power supplies, refer to the ControlLogix Selection Guide, publication 1756-SG001.

In this example, the amount of power dissipated inside the cabinet is the sum of the Kinetix 6000 system value (572 W) and the ControlLogix system value (34 W) for a total of 606 W.

With no active method of heat dissipation (such as fans or air conditioning) either of the following approximate equations can be used.

Metric	Standard English
$A = \frac{0.38Q}{1.8T - 1.1}$	$A = \frac{4.08Q}{T - 1.1}$
Where T is temperature difference between inside air and outside ambient (°C), Q is heat generated in enclosure (Watts), and A is enclosure surface area (m^2). The exterior surface of all six sides of an enclosure is calculated as	Where T is temperature difference between inside air and outside ambient (°F), Q is heat generated in enclosure (Watts), and A is enclosure surface area (ft^2). The exterior surface of all six sides of an enclosure is calculated as
A = 2dw + 2dh + 2wh	A = (2dw + 2dh + 2wh) / 144
Where d (depth), w (width), and h (height) are in meters.	Where d (depth), w (width), and h (height) are in inches.

The maximum ambient rating of the Kinetix 6000 system is 50 °C (122 °F) and if the maximum environmental temperature is 30 °C (86 °F) then Q=606 and T=20 in the equation below.

$$A = \frac{0.38(606)}{1.8(20) - 1.1} \approx 6.59m^2$$

In this example, the enclosure must have an exterior surface of 6.59 meters^2. If any portion of the enclosure is not able to transfer heat, it should not be included in the calculation.

Since the minimum cabinet depth to house the 230V drive (selected for this example) is 200 mm (7.9 in.), then the cabinet needs to be approximately 2100 mm (high) x 1250 mm (wide) x 200 mm (deep).

$$2 \times (0.2 \times 1.25) + 2 \times (0.2 \times 2.1) + 2 \times (1.25 \times 2.1) = 6.59m^2$$

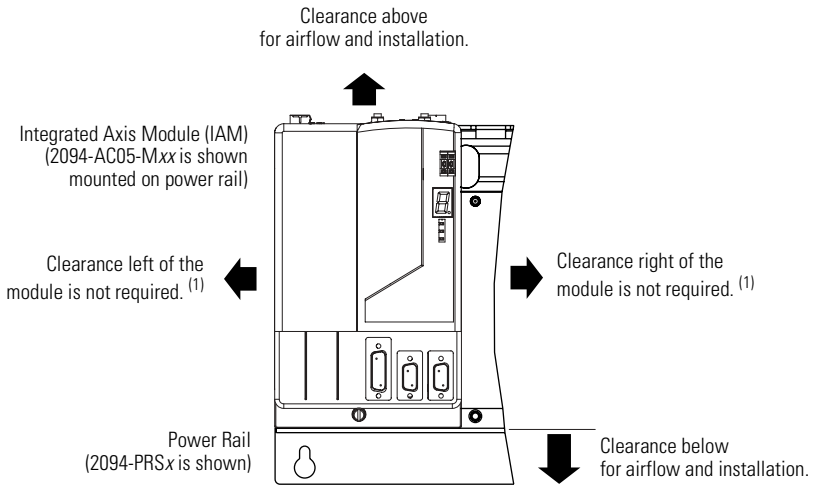
Because this cabinet size is considerably larger than what is necessary to house the system components, it may be more efficient to provide a means of cooling in a smaller cabinet. Contact your cabinet manufacturer for options available to cool your cabinet.

Minimum Clearance Requirements

This section provides information to assist you in sizing your cabinet and positioning your Kinetix 6000 system components.

IMPORTANT Mount the module in an upright position. Do not mount the module on its side.

Minimum Clearance Requirements



(1) The power rail (slim), catalog number 2094-PRS*x*, does not extend left or right of the first or last module (respectively). When using power rail (catalog number 2094-PR*x*) the power rail extends approximately 25.4 mm (1.0 in.) left of the IAM and right of the last module mounted on the rail.

Minimum Clearance Dimensions

Cat. No.	Clearance Above, Min	Clearance Below, Min	Cabinet Depth Clearance, Min
2094-AC05, -AC09, -AMP5, -AM01, -AM02	50.8 mm (2.0 in.)	50.8 mm (2.0 in.)	200 mm (7.9 in.)
2094-BC01, -BC02, -BMP5, -BM01, -BM02			272 mm (10.7 in.)
2094-BSP2			
2094-AC16, -AC32, -AM03, -AM05	305 mm (12.0 in.)	50.8 mm (2.0 in.)	200 mm (7.9 in.)
2094-BC04, -BC07, -BM03, -BM05			272 mm (10.7 in.)

IMPORTANT Although clearance left and right of the power rail is not necessary for ventilation, additional clearance is required when mounted adjacent to noise sensitive equipment or clean wireways.

Refer to page 180 for power dissipation specifications.

Minimizing Electrical Noise

This section outlines best practices which minimize the possibility of noise-related failures as they apply specifically to Kinetix 6000 system installations. For more information on the concept of high-frequency (HF) bonding, the ground plane principle, and electrical noise reduction, refer to the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001.

Bonding Modules

Bonding is the practice of connecting metal chassis, assemblies, frames, shields, and enclosures to reduce the effects of electromagnetic interference (EMI).

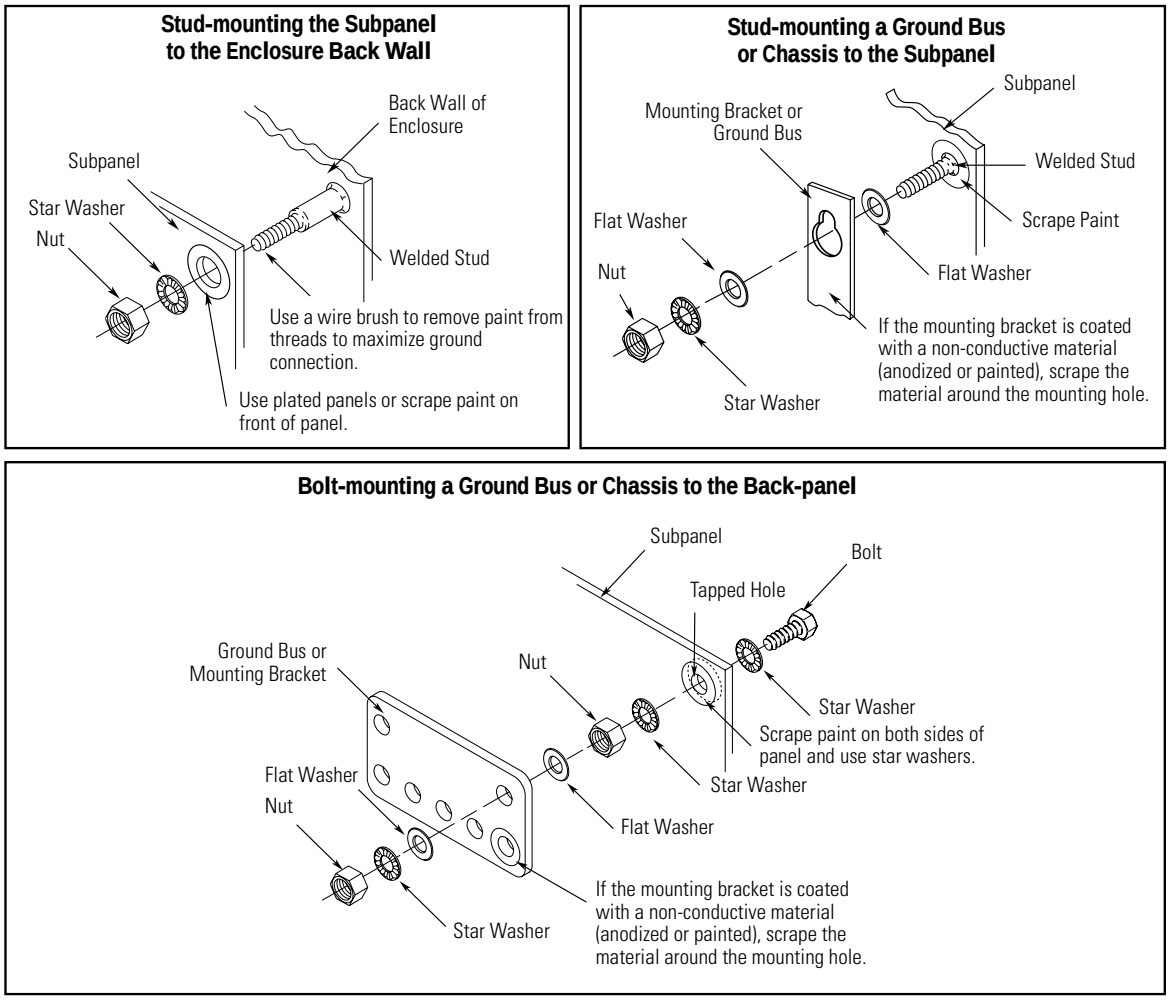
Unless specified, most paints are not conductive and act as insulators. To achieve a good bond between power rail and the subpanel, surfaces need to be paint-free or plated. Bonding metal surfaces creates a low-impedance return path for high-frequency energy.

IMPORTANT To improve the bond between the power rail and subpanel, construct your subpanel out of zinc plated (paint-free) steel.

Improper bonding blocks the direct return path and allows high-frequency energy to travel elsewhere in the cabinet. Excessive high-frequency energy can effect the operation of other microprocessor controlled equipment.

The illustrations that follow show details of recommended bonding practices for painted panels, enclosures, and mounting brackets.

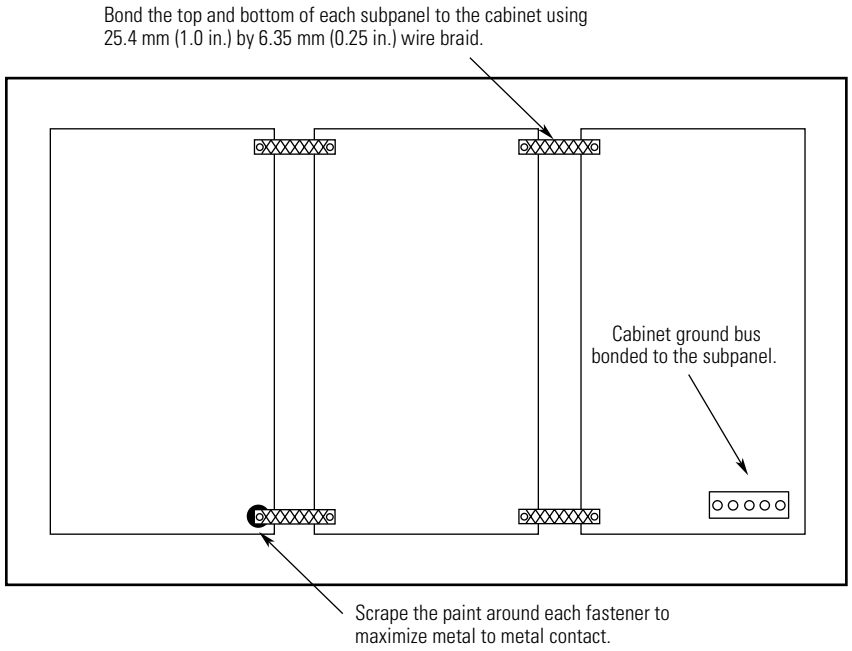
Recommended Bonding Practices for Painted Panels



Bonding Multiple Subpanels

Bonding multiple subpanels creates a common low impedance exit path for the high frequency energy inside the cabinet. Subpanels that are not bonded together may not share a common low impedance path. This difference in impedance may affect networks and other devices that span multiple panels.

Multiple Subpanels and Cabinet Recommendations

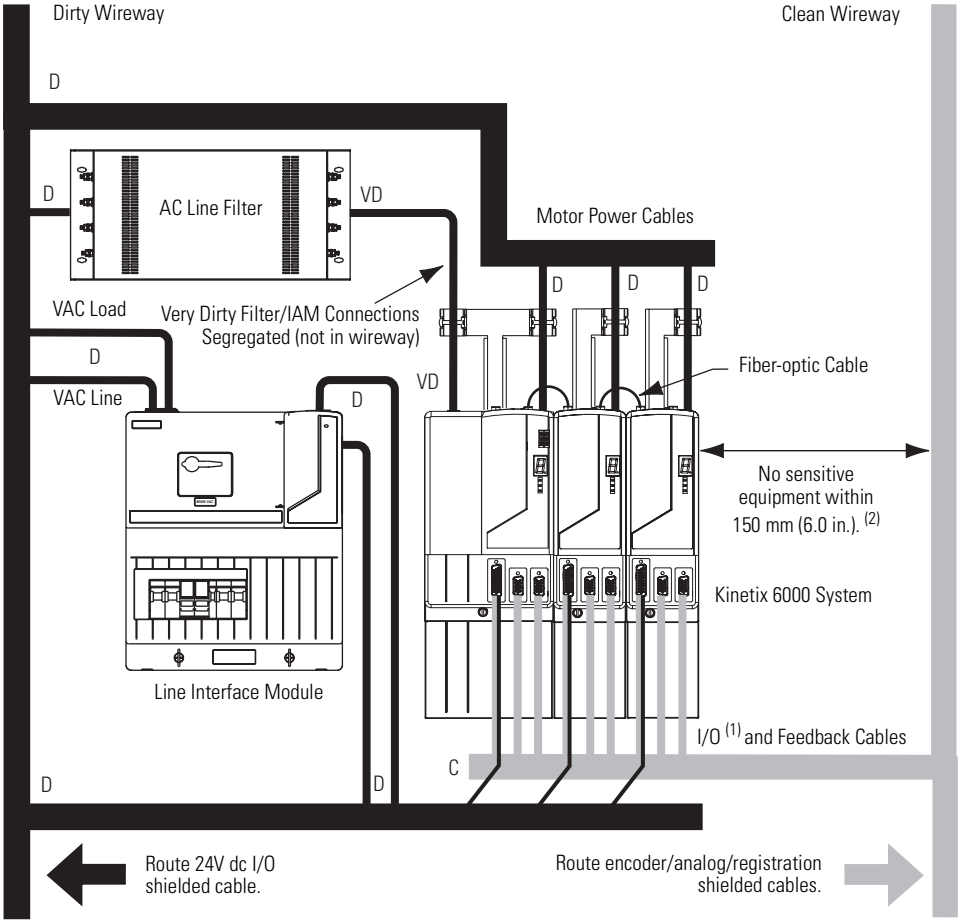


Establishing Noise Zones

Observe the following guidelines when a LIM (2094-AL*xx*S, -BL*xx*S, or -XL75S-C*x*) is used in the Kinetix 6000 system and mounted left of the IAM with the ac (EMC) line filter mounted above the LIM:

- The clean zone (C) is to the right and beneath the Kinetix 6000 system (grey wireway).
- The dirty zone (D) is to the left and above the Kinetix 6000 system, and above and below the LIM (black wireway).
- The very dirty zone (VD) is from the filter output to IAM. Shielded cable is required on the EMC filter (load side) and the braided shield attached to the clamp provided.
- The SERCOS fiber-optic cables are immune to electrical noise.

Establishing Noise Zones (LIM mounted left of IAM)



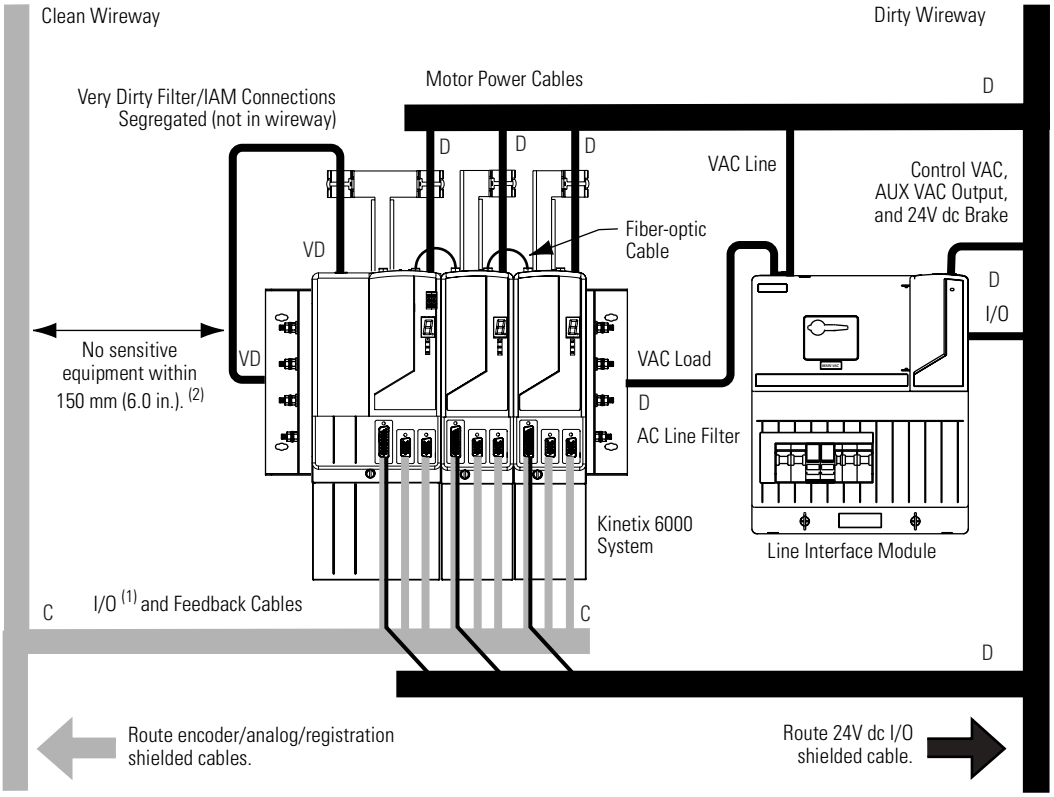
(1) If IAM/AM I/O cable contains (dirty) relay wires, route cable with LIM I/O cable in dirty wireway.

(2) When space does not permit the 150 mm (6.0 in.) segregation, use a grounded steel shield instead. For examples, refer to the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001.

Observe the following guidelines when a LIM (2094-AL*xx*S, -BL*xx*S, or -XL75S-C*x*) is used in the Kinetix 6000 system and mounted right of the IAM with the ac (EMC) line filter mounted behind the IAM:

- The clean zone (C) is to the left and beneath the Kinetix 6000 system (grey wireway).
- The dirty zone (D) is to the right and above the Kinetix 6000 system, and above and below the LIM (black wireway).
- The very dirty zone (VD) is from the filter output to IAM. Shielded cable is required on the EMC filter (load side) and the braided shield attached to the clamp provided.
- The SERCOS fiber-optic cables are immune to electrical noise.

Establishing Noise Zones (LIM with EMC filter behind IAM)



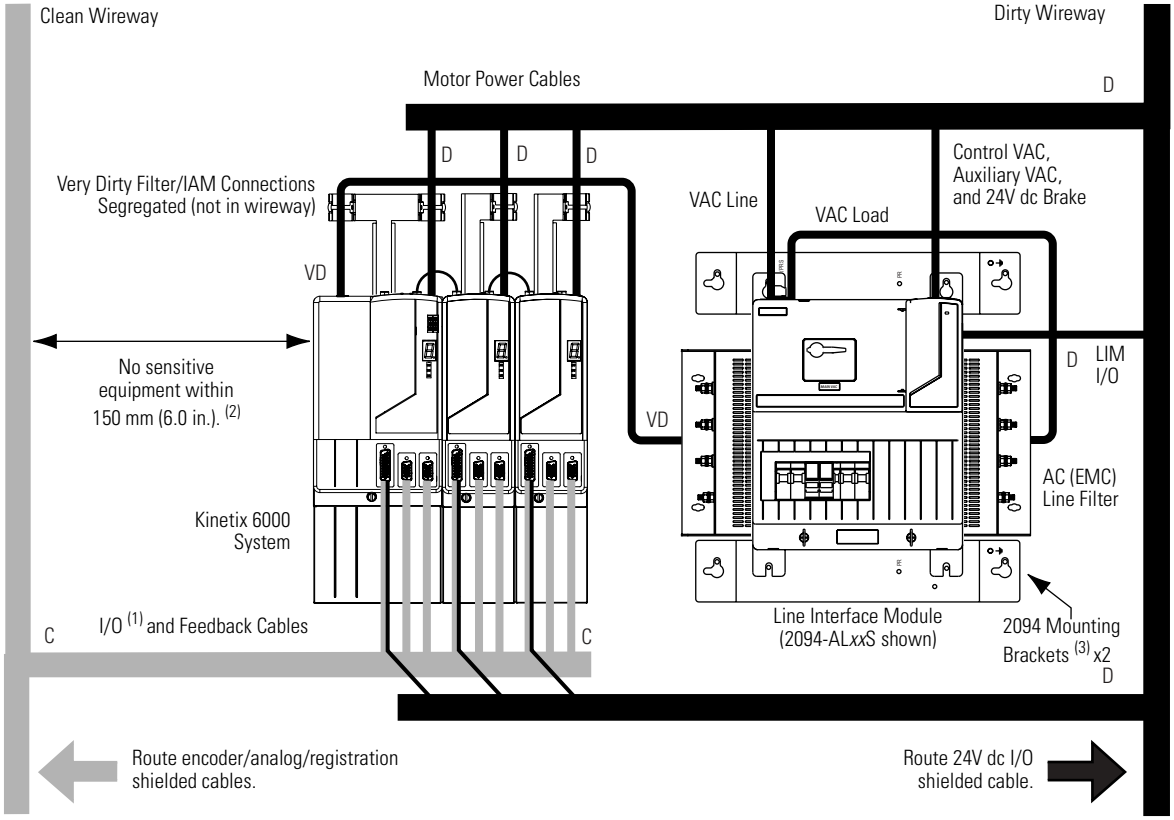
(1) If IAM/AM I/O cable contains (dirty) relay wires, route cable with LIM I/O cable in dirty wireway.

(2) When space does not permit the 150 mm (6.0 in.) segregation, use a grounded steel shield instead. For examples, refer to the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001.

Observe the following guidelines when a LIM (2094-AL*xx*S or -XL*xx*S-C*x*) is used in the Kinetix 6000 system and mounted right of the drive with the ac (EMC) line filter mounted behind the LIM:

- The clean zone (C) is to the left and beneath the Kinetix 6000 system (grey wireway).
- The dirty zone (D) is to the right and above the Kinetix 6000 system, and above and below the LIM (black wireway).
- The very dirty zone (VD) is from the filter output to drive. Shielded cable is required on the EMC filter (load side) and the braided shield attached to the clamp (when provided).

Establishing Noise Zones (EMC filter behind LIM)



(1) If drive system I/O cable contains (dirty) relay wires, route cable with LIM I/O cable in dirty wireway.

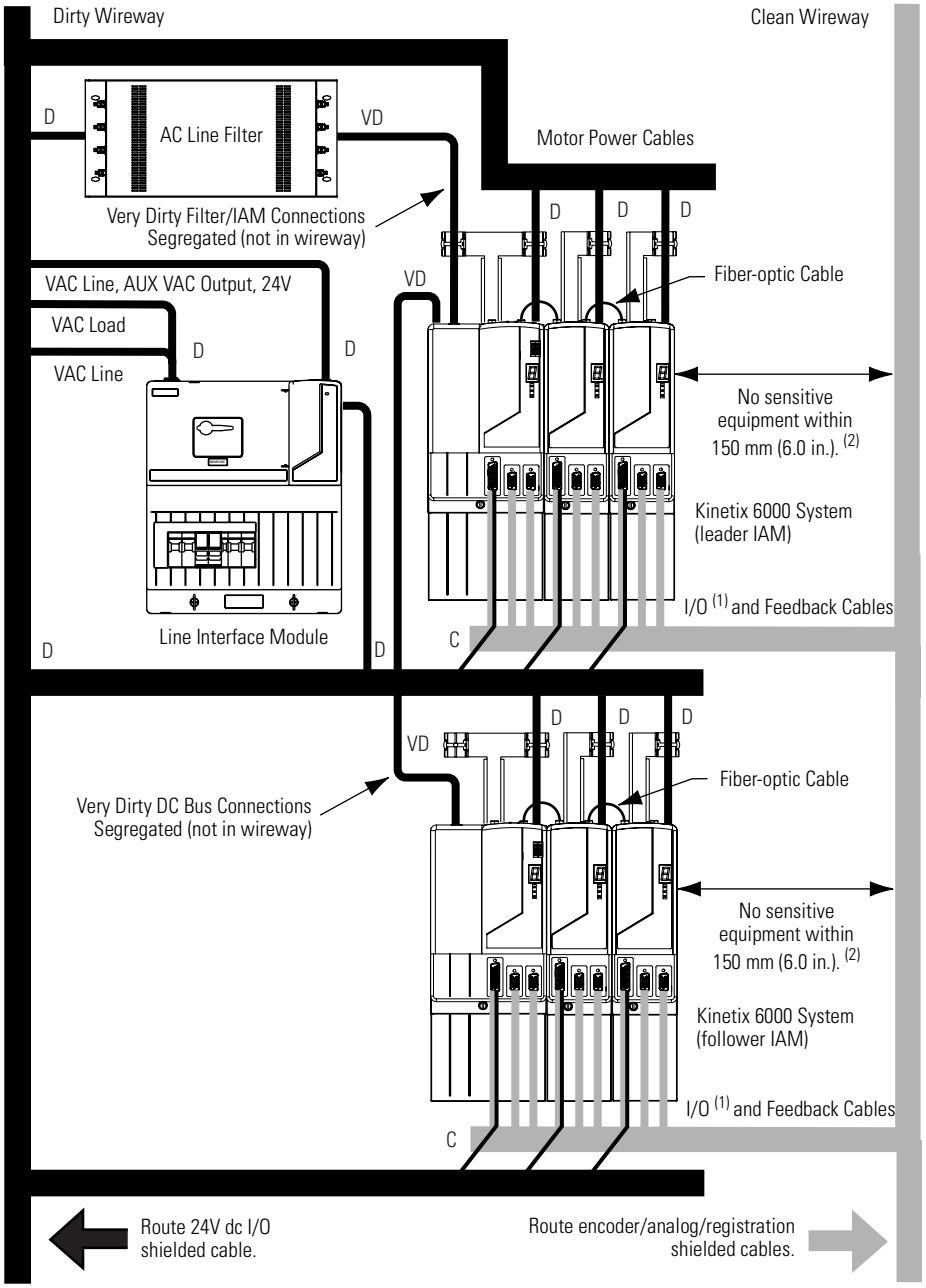
(2) When space does not permit the 150 mm (6.0 in.) segregation, use a grounded steel shield instead. For examples, refer to the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001.

(3) Only the 2094-AL*xx*S and -XL75S-C*x* Line Interface Modules are compatible with the 2094 Mounting Brackets. The 2094-BL*xx*S, -AL09, and -BL02 models are not compatible.

Observe the following guidelines when a LIM (2094-AL*xx*S, -BL*xx*S, or -XL75S-C*x*) is used in a dc common bus configuration and the follower IAM is mounted below the leader IAM:

Keep the dc common bus cable (very dirty) segregated from all other cables (not in a wireway).

Establishing Noise Zones (dc common bus)



(1) If IAM/AM I/O cable contains (dirty) relay wires, route cable with LIM I/O cable in dirty wireway.

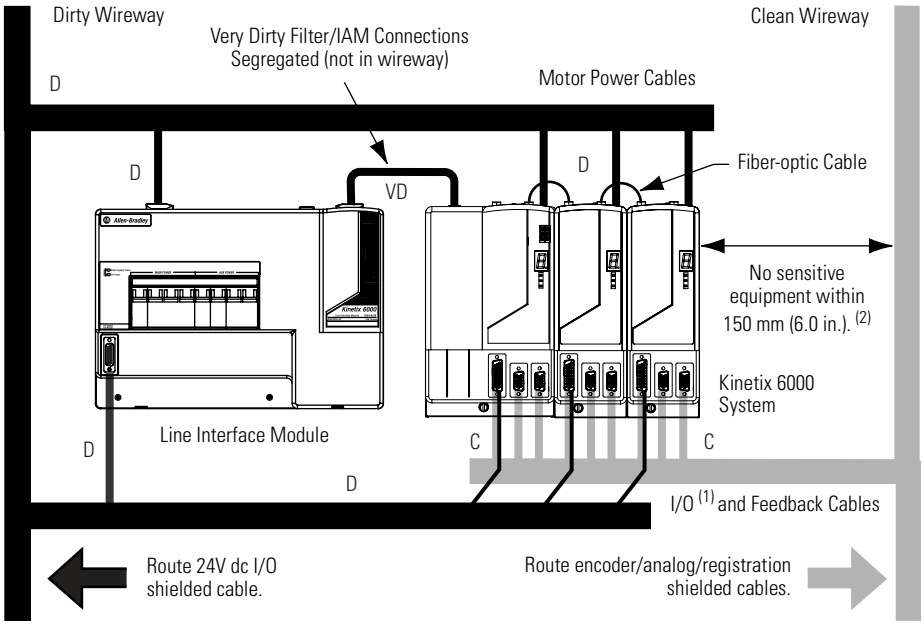
(2) When space does not permit the 150 mm (6.0 in.) segregation, use a grounded steel shield instead. For examples, refer to the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001.

Observe the following guidelines when a LIM (2094-AL09 or -BL02) is used in the Kinetix 6000 system and mounted left of the IAM:

This layout is preferred due to the reduced size of the very dirty zone.

- The clean zone (C) is to the right and beneath the Kinetix 6000 system (grey wireway).
- The dirty zone (D) is to the left and above the Kinetix 6000 system, and above and below the LIM (black wireway).
- The very dirty zone (VD) is limited to where the LIM VAC output jumpers over to the IAM. Shielded cable is required only if the very dirty cables enter a wireway.
- The SERCOS fiber-optic cables are immune to electrical noise.

Establishing Noise Zones (LIM mounted left of IAM)



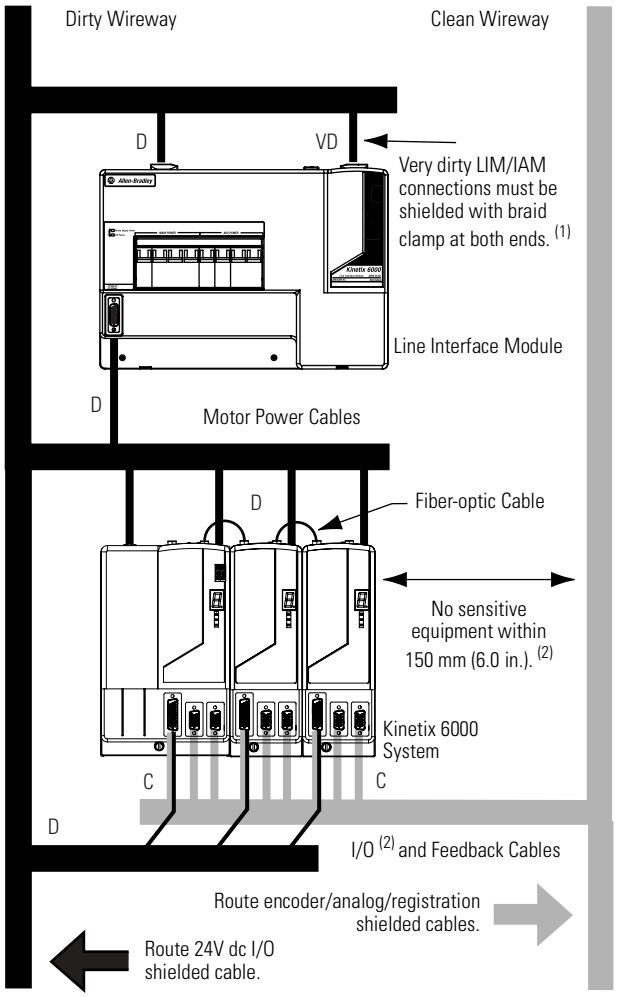
(1) If IAM/AM I/O cable contains (dirty) relay wires, route cable with LIM I/O cable in dirty wireway.

(2) When space does not permit the 150 mm (6.0 in.) segregation, use a grounded steel shield instead. For examples, refer to the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001.

Observe the following guidelines when a LIM (2094-AL09 or -BL02) is used in the Kinetix 6000 system and mounted above the IAM:

- The clean zone (C) is to the right and beneath the Kinetix 6000 system (grey wireway).
- The dirty zone (D) is to the left and above the Kinetix 6000 system, and above and below the LIM (black wireway).
- The LIM VAC output is very dirty (VD). Use shielded cable with a braid clamp attached at both ends of the cable to reduce the rating to dirty (D).
- The SERCOS fiber-optic cables are immune to electrical noise.

Establishing Noise Zones (LIM mounted above IAM)



(1) For examples of shield clamp attachment, refer to the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001.

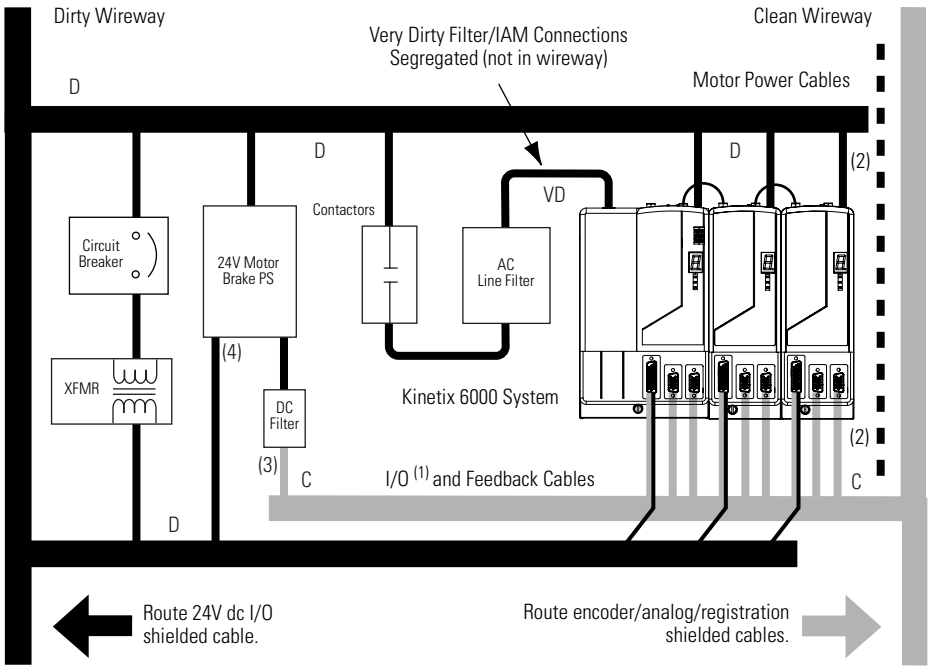
(2) If IAM/AM I/O cable contains (dirty) relay wires, route cable in dirty wireway.

(3) When space does not permit the 150 mm (6.0 in.) segregation, use a grounded steel shield instead. For examples, refer to the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001.

Observe the following guidelines when individual input power components are used in the Kinetix 6000 system and the LIM (2094-*x*L*xx* or -*x*L*xx*S-*xx*) is not used:

- The clean zone (C) is beneath the Kinetix 6000 system and includes the I/O wiring, feedback cable, and dc filter (grey wireway).
- The dirty zone (D) is above the Kinetix 6000 system (black wireway) and includes the circuit breakers, transformer, 24V dc power supply, contactors, ac line filter, and motor power cables.
- The very dirty zone (VD) is limited to where the ac line (EMC) filter VAC output jumpers over to the IAM. Shielded cable is required only if the very dirty cables enter a wireway.
- The SERCOS fiber-optic cables are immune to electrical noise.

Establishing Noise Zones (No LIM)



(1) If IAM/AM I/O cable contains (dirty) relay wires, route cable in dirty wireway.

(2) When space to the right of the IAM does not permit 150 mm (6.0 in.) segregation, use a grounded steel shield instead. For examples, refer to the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001.

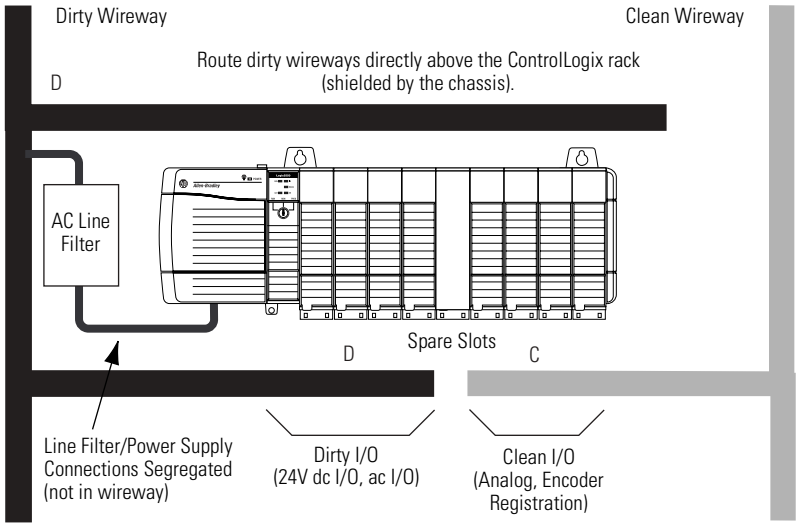
(3) This is a clean 24V dc available for any device that may require it. The 24V enters the clean wireway and exits to the right.

(4) This is a dirty 24V dc available for motor brakes and contactors. The 24V enters the dirty wireway and exits to the left.

Observe the following guidelines when installing your 1756-M*xx*SE SERCOS interface module:

- The clean zone (C) is beneath the less noisy modules (I/O, analog, encoder, registration, etc. (grey wireway).
- The dirty zone (D) is above and below the power supply and noisy modules (black wireway).
- The SERCOS fiber-optic cables are immune to electrical noise.

Establishing Noise Zones (ControlLogix)



Cable Categories for Kinetix 6000 Systems

The table below indicates the zoning requirements of cables connecting to the Kinetix 6000 drive components.

Integrated Axis Module (converter side)

Wire/Cable	Connector	Zone			Method	
		Very Dirty	Dirty	Clean	Ferrite Sleeve	Shielded Cable
CTRL 1 and 2	CPD		X			
DC-/DC+ (unshielded cable)	IPD	X				
L1, L2, L3 (shielded cable)			X			X
L1, L2, L3 (unshielded cable)		X				
CONT EN- and CONT EN+ (M1 contactor)	CED		X			
DPI	DPI			X		X

Integrated Axis Module or Axis Module (inverter side)

Wire/Cable	Connector	Zone			Method	
		Very Dirty	Dirty	Clean	Ferrite Sleeve	Shielded Cable
U, V, W (motor power)	MP		X			X
MBRK-, MBRK+ (motor brake)	BC		X			
MBRK-, MBRK+ (motor brake) 1326AB motors with resolver feedback			X		X	
DBRK-, DBRK+ (resistive brake)			X			
COM, PWR (24V dc), filtered (1)				X		
COM, PWR (24V dc), unfiltered (2)			X			
COM, PWR (24V dc), safety enable, and feedback signals for safe-off feature	SO		X			
Motor feedback	MF			X		X
Auxiliary feedback	AF			X		X
Registration and analog outputs	IOD			X		X
Others			X			
Fiber-optic	Rx and Tx	No Restrictions				

(1) This is a clean 24V dc available for any device that may require it.

(2) This is a dirty 24V dc available for motor brakes and contactors.

Line Interface Module

Wire/Cable	Connector	Zone			Method	
		Very Dirty	Dirty	Clean	Ferrite Sleeve	Shielded Cable
VAC line (main input)	IPL		X			
230V ac input	APL		X			
VAC load (shielded option)	OPL		X			X
VAC load (unshielded option)		X				
Control power output	CPL		X			
MBRK PWR, MBRK COM	P1L/PSL		X			
Status I/O	IOL		X			
Auxiliary 230V ac	P2L		X			

External Shunt Resistor Kit

Wire/Cable	Connector	Zone			Method	
		Very Dirty	Dirty	Clean	Ferrite Sleeve	Shielded Cable
COL, DC+ (shielded option)	RC		X			X
COL, DC+ (unshielded option)		X				
Thermal switch	TS		X			X
Fan (if present)	N/A		X			

Resistive Brake Module

Wire/Cable	Connections	Zone			Method	
		Very Dirty	Dirty	Clean	Ferrite Sleeve	Shielded Cable
Resistive brake module coil power	TB3-6 and TB3-7		X			
Resistive brake module I/O	TB1-1...-5 and TB3-8		X			
Resistive brake module drive and motor power	TB1 and TB2		X			X
230V power	TB4		X			

Noise Reduction Guidelines for Drive Accessories

When mounting an ac (EMC) line filter or external shunt resistor refer to the sections below for guidelines designed to reduce system failures caused by excessive electrical noise.

AC Line Filters

Observe the following guidelines when mounting your ac (EMC) line filter (refer to the figure on page 36 for an example):

- Mount the ac line filter on the same panel as the Kinetix 6000 drive and as close to the power rail as possible.
- Good HF bonding to the panel is critical. For painted panels, refer to the examples on page 28.
- Segregate input and output wiring as far as possible.

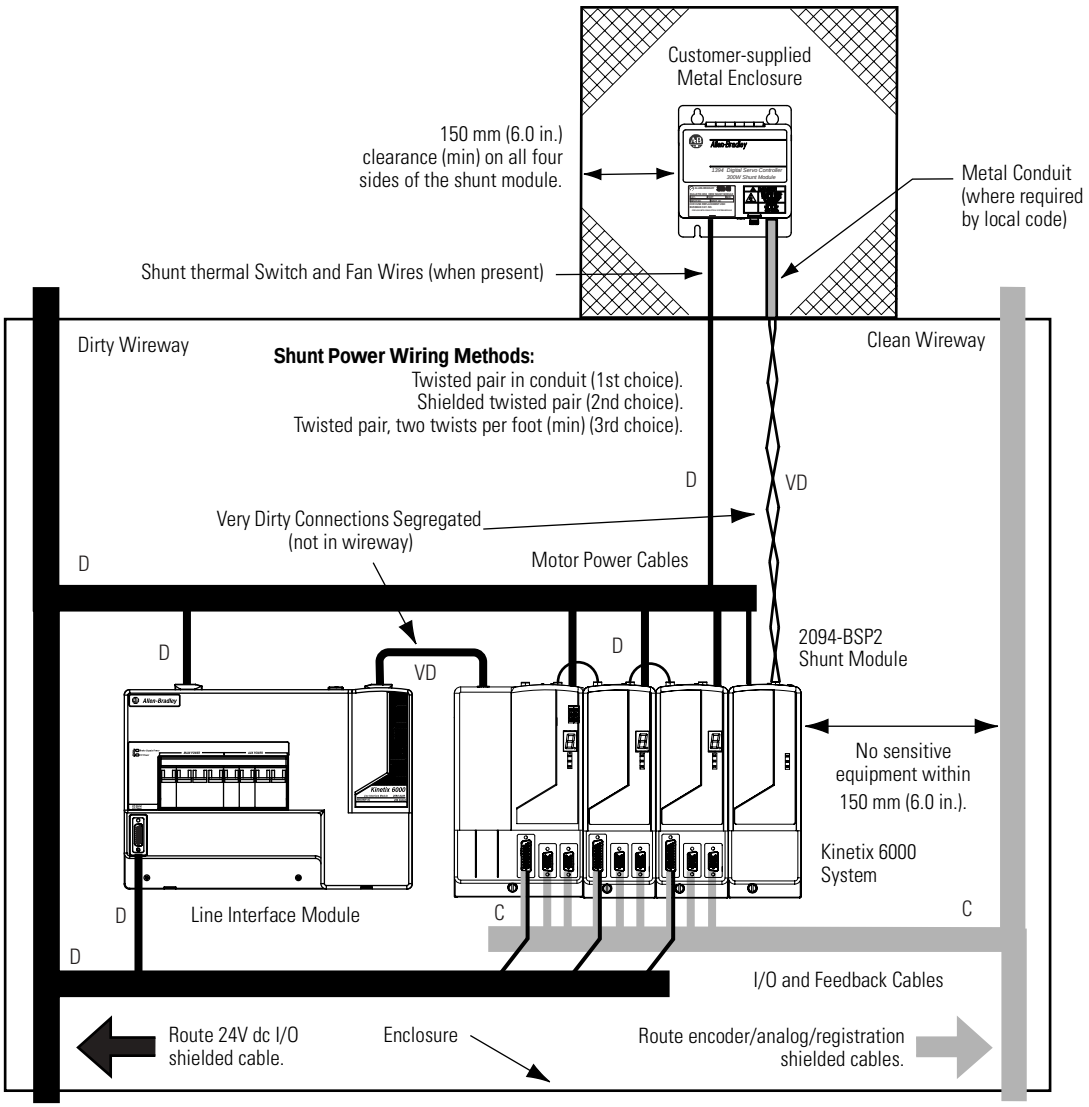
IMPORTANT CE test certification applies only to ac line filter and single power rail. Sharing a line filter with multiple power rails may perform satisfactorily, but the user takes legal responsibility.

External Shunt Resistor

Observe the following guidelines when mounting your external shunt resistor outside the enclosure:

- Mount circuit components and wiring in the very dirty zone or in an external shielded enclosure. Run shunt power and fan wiring inside metal conduit to minimize the effects of EMI and RFI.
- Mount resistors (other than metal-clad) in a shielded and ventilated enclosure outside the cabinet
- Keep unshielded wiring as short as possible. Keep shunt wiring as flat to the cabinet as possible.
- Route thermal switch and fan wires separate from shunt power.

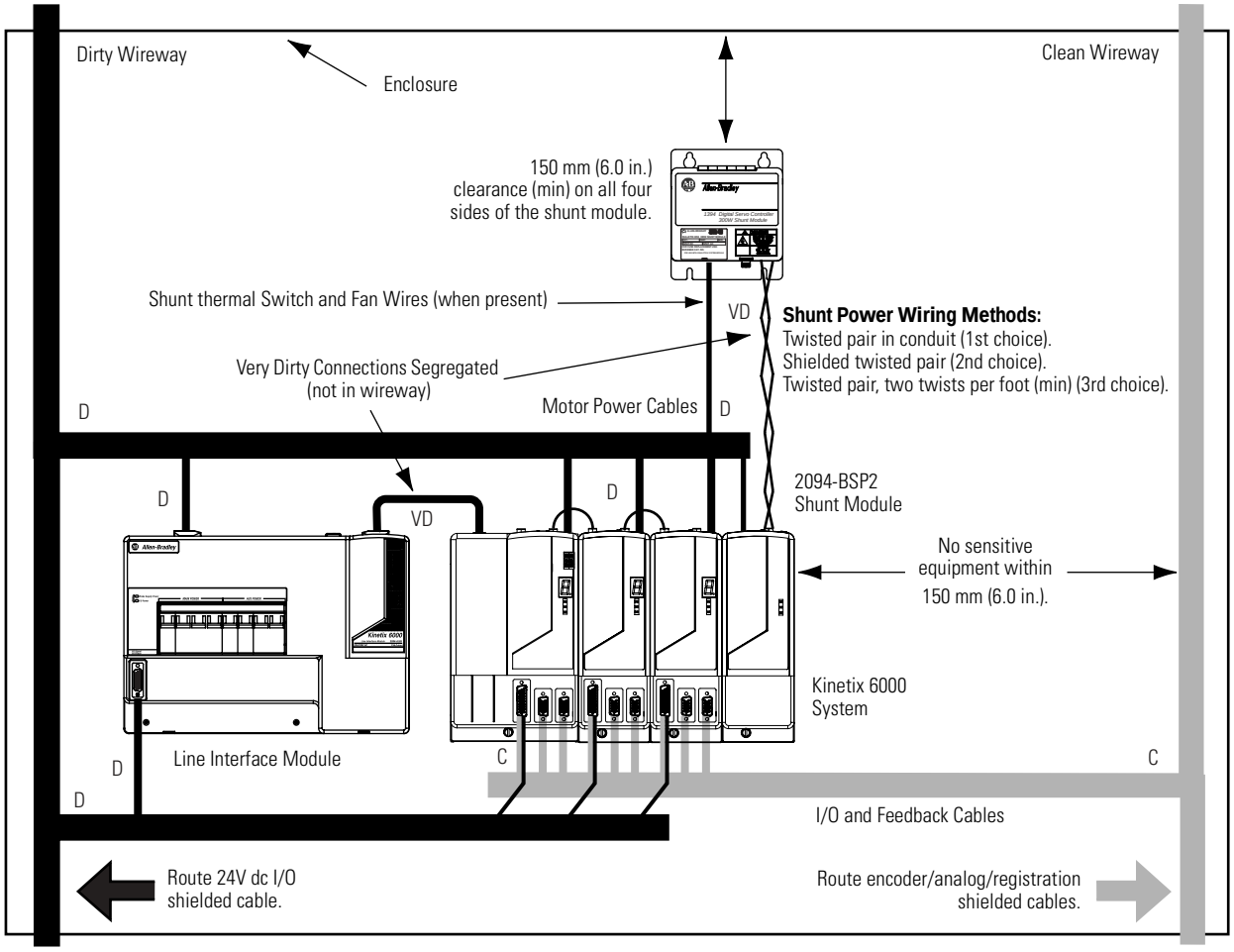
External Shunt Resistor Outside the Enclosure



When mounting your shunt module inside the enclosure, follow these additional guidelines:

- Metal-clad modules can be mounted anywhere in the dirty zone, but as close to the Kinetix 6000 system as possible.
- Shunt power wires can be run with motor power cables.
- Keep unshielded wiring as short as possible. Keep shunt wiring as flat to the cabinet as possible.
- Separate shunt power cables from other sensitive, low voltage signal cables.

External Shunt Resistor Inside the Enclosure

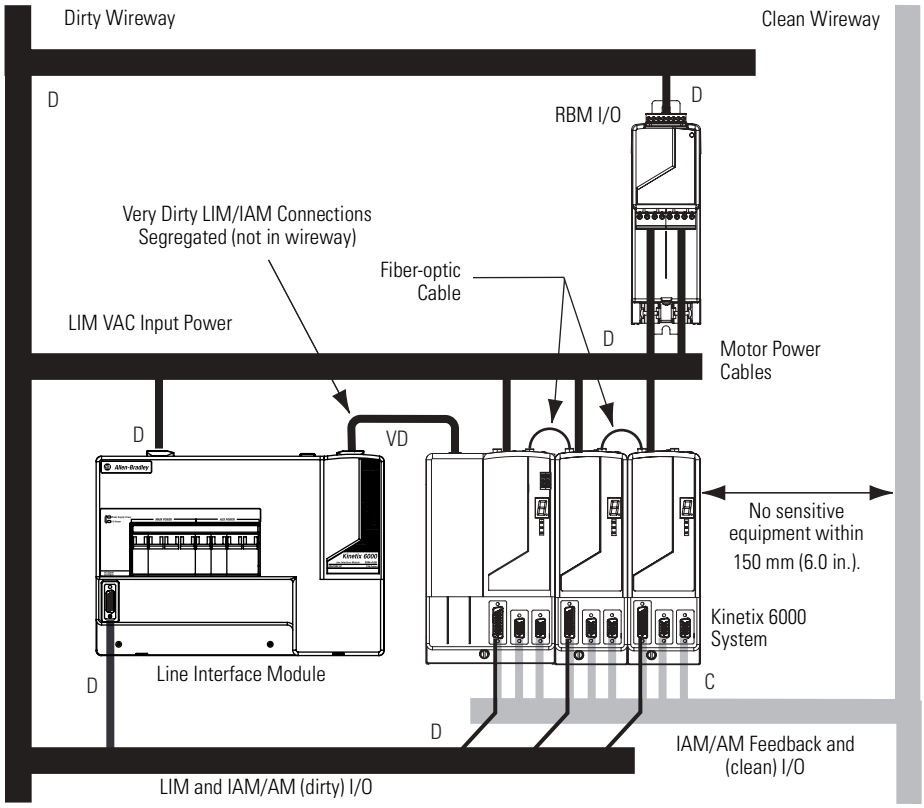


Resistive Brake Modules

Observe the following guidelines when mounting your resistive brake module (RBM):

- Mount circuit components and wiring in the dirty zone or in an external shielded enclosure. If mounting the RBM in a separate ventilated shielded enclosure, run wiring inside metal conduit to minimize the effects of EMI and RFI.
- Keep unshielded wiring as short as possible. Keep wiring as flat to the cabinet as possible.
- Route RBM power and I/O cables separate from other sensitive low voltage signal cables.

Establishing Noise Zones (RBM mounted above AM)



Motor Brake and Thermal Switch

The thermal switch and brake are mounted inside the motor, but how you connect to the axis module depends on the motor series.

Refer to Wiring the Motor/Resistive Brake (BC) Connector on page 101 for wiring guidelines. Refer to Axis Module/Motor Wiring Examples beginning on page 204 for the interconnect diagram of your drive/motor combination.

Mounting the Kinetix 6000 Drive System

Introduction

This chapter provides the system installation procedures for mounting your Kinetix 6000 drive components to the panel.

The procedures in this chapter assume you have prepared your panel and understand how to bond your system. For installation instructions regarding equipment and accessories not included here, refer to the instructions that came with those products.

SHOCK HAZARD

To avoid hazard of electrical shock, perform all mounting and wiring of IAM, AM, SM, LIM, RBM, or power rail prior to applying power. Once power is applied, connector terminals may have voltage present even when not in use.

ATTENTION

Plan the installation of your system so that you can perform all cutting, drilling, tapping, and welding with the system removed from the enclosure. Because the system is of the open type construction, be careful to keep any metal debris from falling into it. Metal debris or other foreign matter can become lodged in the circuitry, which can result in damage to components.

Using 2094 Mounting Brackets

Bulletin 2094 mounting brackets can be used to mount the power rail or line interface module over the ac line filter. Refer to the 2094 Mounting Brackets Installation Instructions, publication 2094-IN008, when using mounting brackets with your Kinetix 6000 drive system.

Installing the 2094 Power Rail

The Kinetix 6000 power rail comes in lengths to support one integrated axis module (IAM), and up to seven additional axis modules (AM) or shunt module (SM). The connector pins for each slot are covered by a protective boot. The boot is designed to protect the pins from damage and make sure that no foreign objects lodge between the pins during installation. Refer to the Kinetix 6000 Power Rail Installation Instructions, publication 2094-IN003, when installing your power rail.

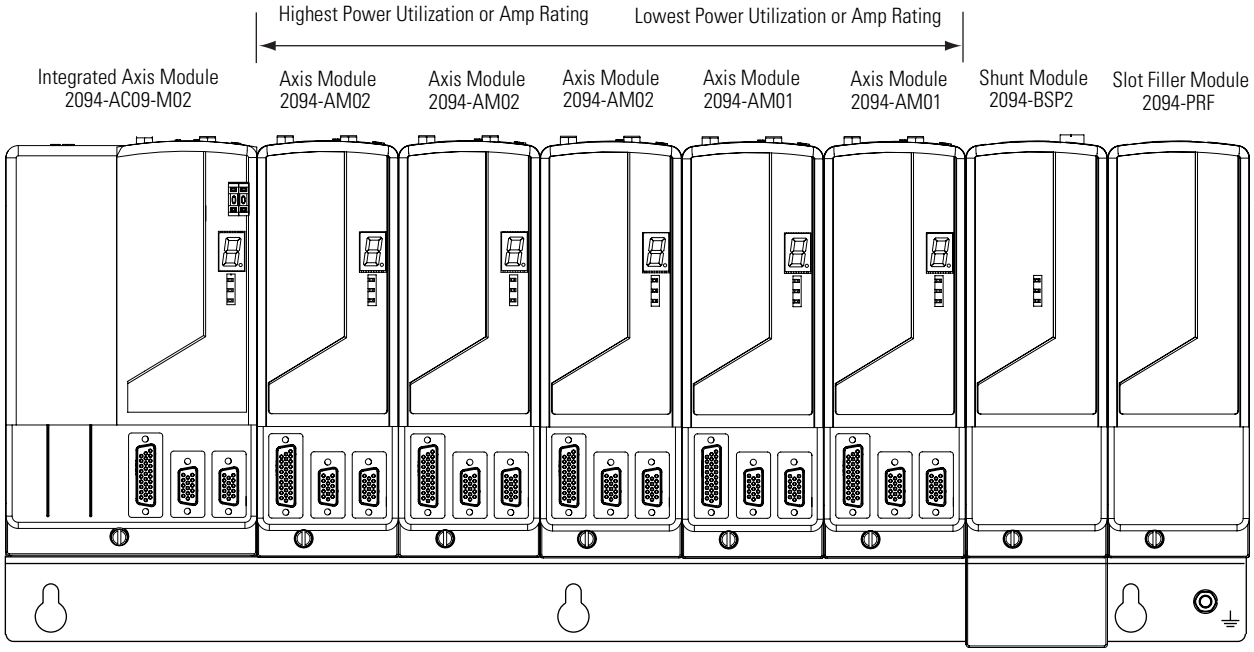
ATTENTION

To avoid damage to the power rail during installation, do not remove the protective boots until the module for each slot is ready for mounting.

Determining Mounting Order

Mount IAM, AM, SM, and slot filler (PRF) modules in the order (left to right) as shown in the figure below. Mount axis modules according to power utilization (highest to lowest) from left to right starting with the highest power utilization. If power utilization is unknown, position axis modules (highest to lowest) from left to right based on amp rating.

Module Mounting Order



IMPORTANT The integrated axis module (IAM) must be positioned in the leftmost slot of the power rail. Position your axis modules (AM), shunt module (SM), and slot fillers (PRF) to the right of the IAM.

The SM must be installed to the right of the last AM. Only slot filler modules may be installed to the right of the SM.

Do not mount the SM on power rails with a follower IAM. Common-bus follower IAMs will disable the internal, rail mounted, and external shunt modules.

SHOCK HAZARD

To avoid personal injury due to electrical shock, place a slot filler module (catalog number 2094-PRF) in all empty slots on the power rail.

Any power rail connector without a module installed will disable the Kinetix 6000 system, however control power will still be present.

Mounting the Modules

Follow these steps to mount the IAM, AM, SM, and PRF modules. All modules mount to the power rail using the same technique (integrated axis module is shown).

1. Remove the protective boots from the power rail connectors.

IMPORTANT The IAM must be positioned in the leftmost slot of the power rail. Position your axis modules, shunt module, and slot fillers to the right of the IAM.

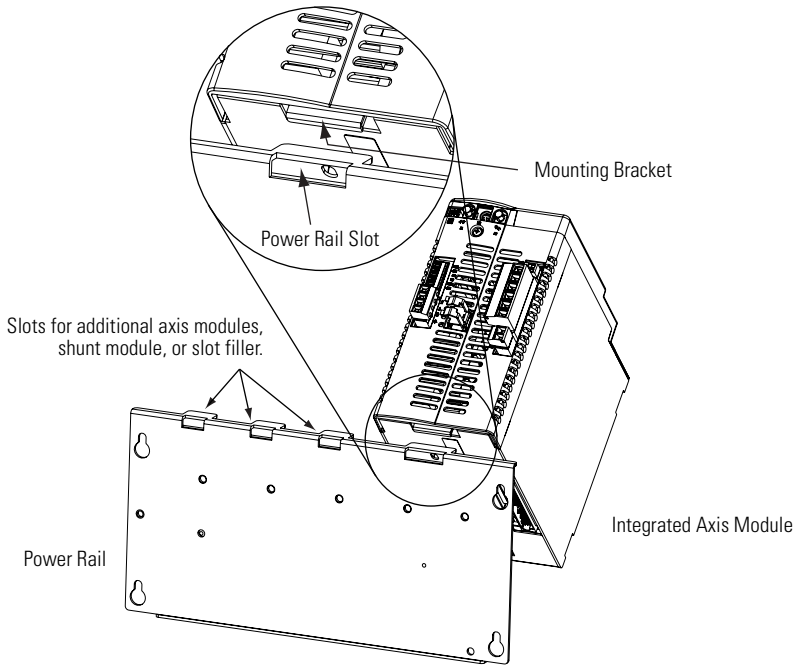
2. Determine the next available slot and module for mounting.
3. Remove the label (applied to back and side of module) covering the pins that mate with the power rail.

ATTENTION

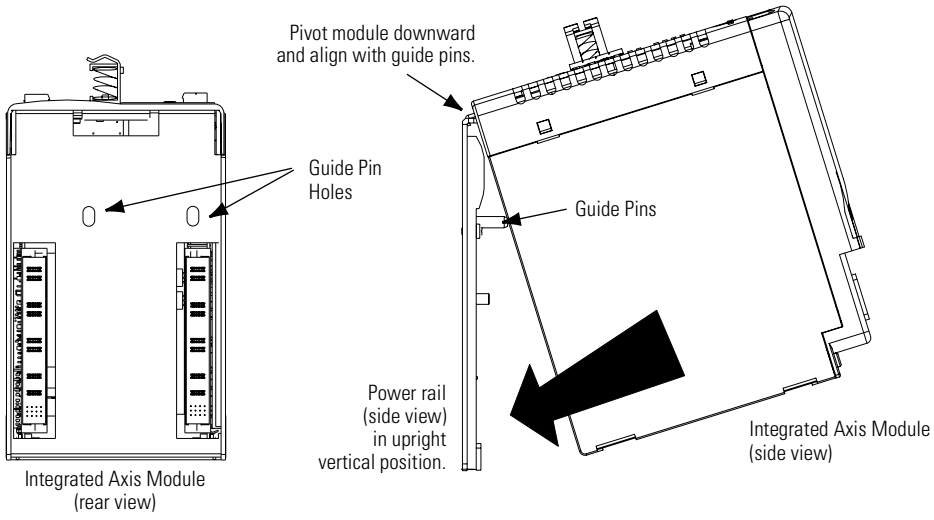
To avoid damage to the pins located on the back of each module (IAM, AM, SM, and PRF) and to make sure that module pins mate properly with the power rail, hang modules as shown in Steps 4...7.

The power rail must be mounted vertically on the panel before hanging modules on the power rail. Do not mount modules if the power rail is horizontal.

4. Hang the mounting bracket from the slot on the power rail.

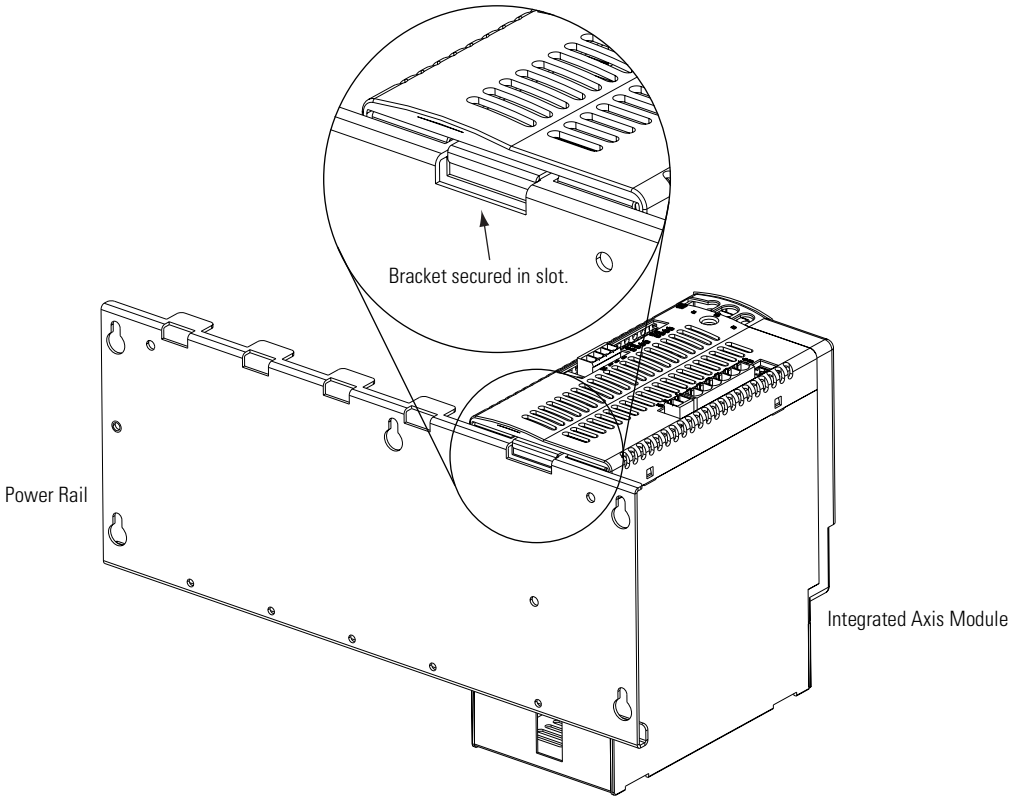


5. Pivot module downward and align the guide pins on the power rail with the guide pin holes in the back of the module.

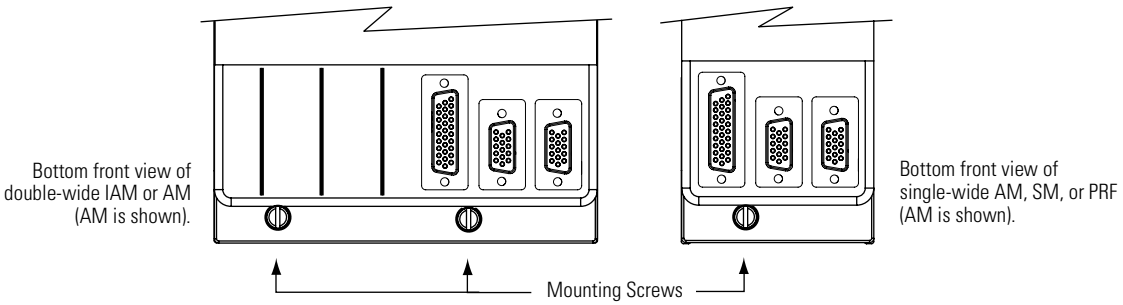


TIP The IAM can have two or three power rail connectors and guide pins, the AM can have one or two, all other modules have one.

6. Gently push the module against the power rail connectors and into the final mounting position.



7. Use 2.26 Nm (20 lb-in.) torque to tighten the mounting screws.



IMPORTANT There are two mounting screws when mounting 2094-AC32-M05, -BC04-M03, and -BC07-M05 (double-wide) IAMs and 2094-AM05, -BM03, and -BM05 (double-wide) AMs.

8. Determine if you have additional modules to mount.

If You	Then
Have additional modules to mount	Return to Step 1 and complete installation of your next AM, SM, or PRF module.
Do not have additional modules to mount	Go to Mounting the External Shunt Module.

Mounting the External Shunt Module

If your Kinetix 6000 drive requires a means of dissipating regenerative energy that exceeds the capacity of the 2094 shunt module, install a Bulletin 1394 external shunt module.

BURN HAZARD

To avoid the hazard of shock or burn and ignition of flammable material, appropriate guarding must be provided. These resistors can reach temperatures in excess of 350 ° C (662 ° F). Install per local codes.

Follow these steps to install your external shunt module.

1. Layout the position for your shunt module in the enclosure.

   Follow the panel layout recommendations as shown in External Shunt Resistor on page 40.

2. Attach the shunt resistor to the cabinet. The recommended mounting hardware is M6 metric (1/4 in.) bolts.

   Follow the recommended high-frequency (HF) bonding techniques as shown in the Bonding Modules on page 27.

3. Tighten all mounting fasteners.

For external shunt module mounting dimensions, refer to the Kinetix Motion Control Selection Guide, publication GMC-SG001.

Kinetix 6000 Connector Data

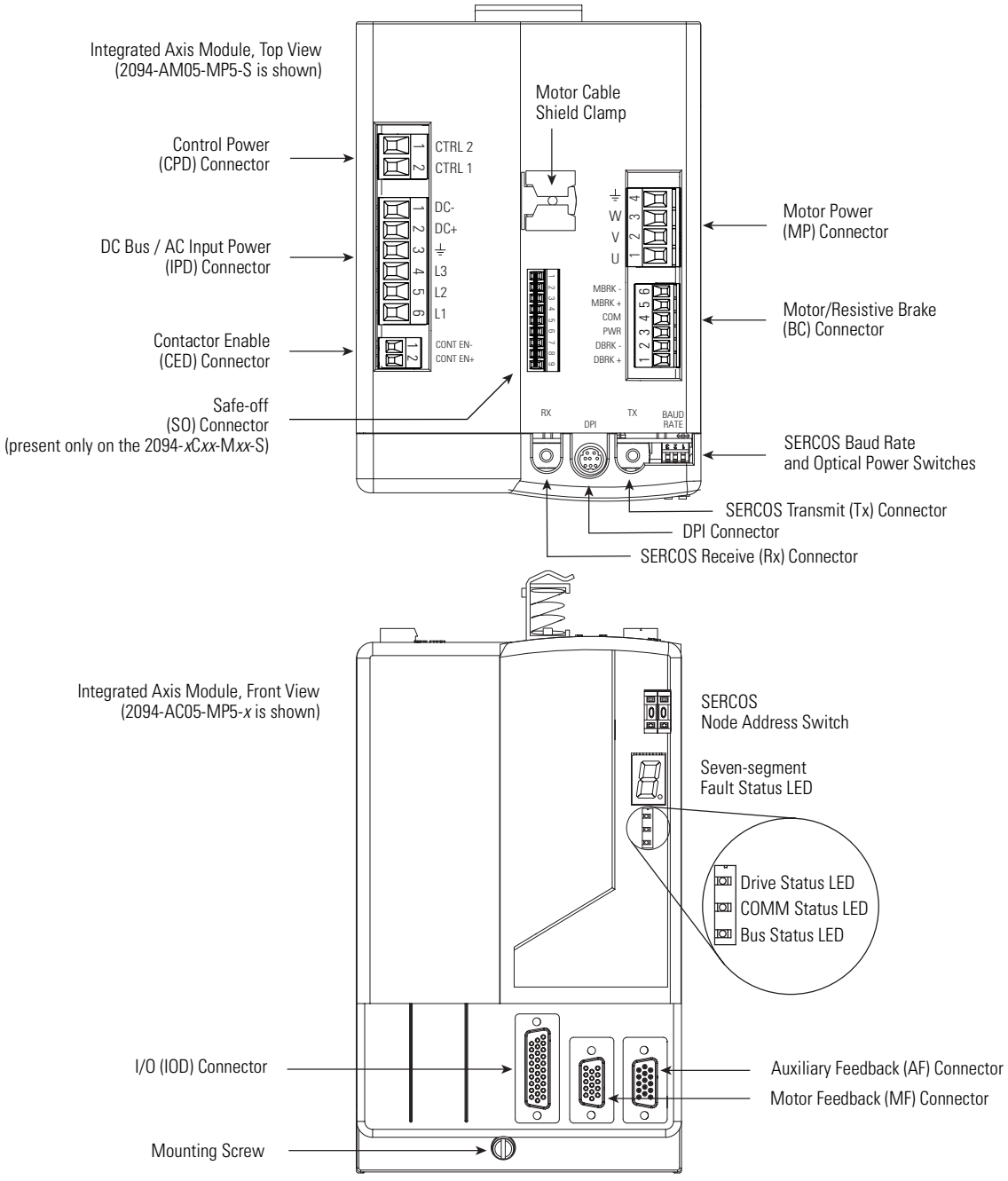
Introduction

This chapter provides power, feedback, and I/O connector locations and signal descriptions for your Kinetix 6000 drive.

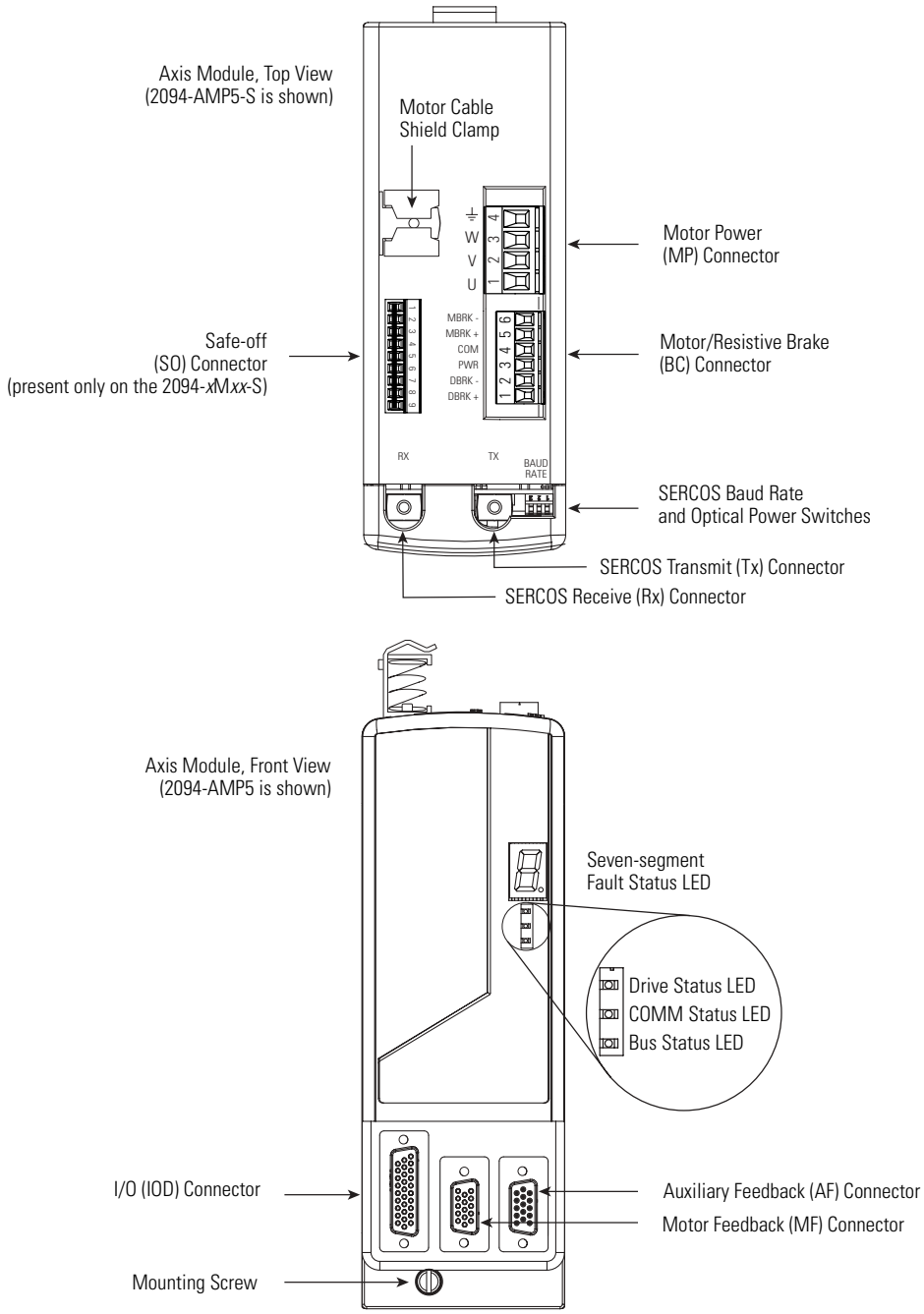
Locating IAM/AM Connectors and Indicators

Although the physical size of the 460V modules is larger than the 230V modules, the location of the connectors and indicators is identical.

Integrated Axis Module Connectors and Indicators



Axis Module Connectors and Indicators



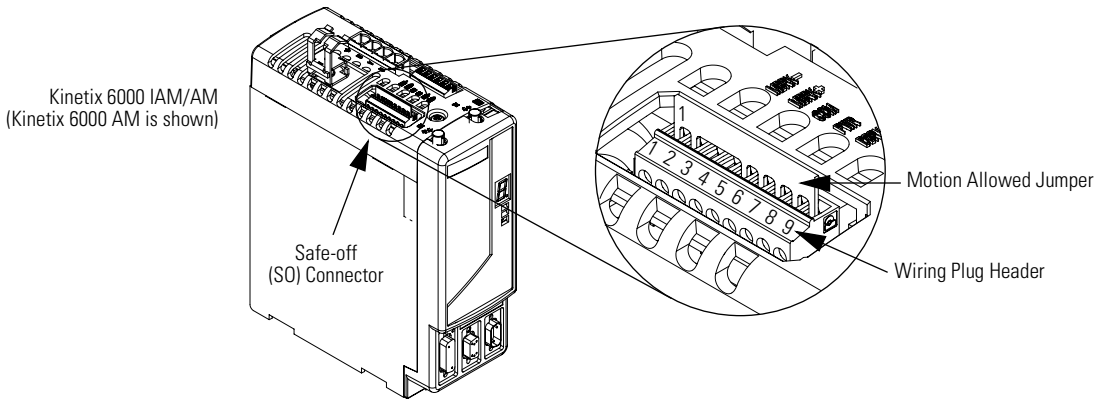
Integrated Axis Module/Axis Module Connectors

Designator	Description	Connector	Present on IAM or AM
IOD	User I/O (drive)	26-pin high-density D-shell	IAM/AM
MF	Motor feedback	15-pin high-density D-shell (female)	IAM/AM
AF	Auxiliary feedback	15-pin high-density D-shell (male)	IAM/AM
CPD	Control input power (drive)	2-position plug/header	IAM
IPD	VAC Input Power (drive) 230V and dc bus	6-position plug/header	IAM
	VAC Input Power (drive) 460V and dc bus	6-position plug/header	IAM
CED	Contactor enable	2-position plug/header	IAM
MP	Motor power	4-position plug/header	IAM/AM
BC	Dynamic/motor brake	6-position plug/header	IAM/AM
SO	Safe-off	9-position plug/header	IAM/AM
Tx and Rx	SERCOS transmit and receive	SERCOS fiber-optic (2)	IAM/AM
DPI	DPI	DPI	IAM

Safe-off Connector Pinout

Each IAM (2094-*x*C*xx*-M*xx*-S) and AM (2094-*x*M*xx*-S) ships with the (9-pin) wiring plug header and motion allowed jumper installed in the safe-off (SO) connector. With the motion allowed jumper installed, the safe-off feature is not used.

Motion Allowed Jumper



Headers in this table extend the safe-off (SO) connector signals for use in wiring single and multiple safe-off drive configurations, or to jumper around (not use) the safe-off feature.

IAM/AM Safe-off 9-pin (SO) Connector

Safe-off (SO) Connector Pin	Also Applies to These SO Connector Headers	Description	Signal
1	• Wiring plug header • First-drive wiring header (2090-XNSM-W)	One side of the normally-closed monitoring contact of relay 2	FDBK2+
2		Other side of the normally-closed monitoring contact of relay 2	FDBK2-
3		One side of the normally-closed monitoring contact of relay 1	FDBK1+
4		Other side of the normally-closed monitoring contact of relay 1	FDBK1-
5		Coil of safety-relay 2	SAFETY ENABLE2+
6		Return for safety-relay coil power (both relays)	SAFETY ENABLE-
7		Coil of safety relay 1	SAFETY ENABLE1+
8	• Wiring plug header • Motion allowed jumper	Power for continuous enable of the safety function, 500 mA max	24V+
9		Power return used for continuous enable of safety function	24V_COM

IMPORTANT Pins SO-8 and -9 (24V+) are only used by the motion allowed jumper. When wiring to the wiring plug header, the 24V supply must come from an external source.

Refer to the Kinetix Safe-off Feature Safety Reference Manual, publication GMC-RM002, for more information on safe-off headers.

I/O Connector Pinout

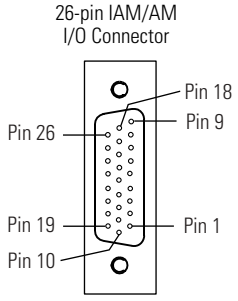
IAM/AM I/O 26-pin (IOD) Connector

IOD Pin	Description	Signal
1	Hardware enable 24V dc power supply	+24V_PWR
2	Hardware enable input	ENABLE
3	Common	+24V_COM
4	Home switch 24V dc power supply	+24V_PWR
5	Home switch input	HOME
6	Common	+24V_COM
7	Positive overtravel 24V dc power supply	+24V_PWR
8	Positive overtravel limit switch input	OT+
9	Common	+24V_COM
10	Negative overtravel 24V dc power supply	+24V_PWR
11	Negative overtravel limit switch input	OT-
12	Common	+24V_COM
13	24V registration power	REG_24V

IOD Pin	Description	Signal
14	High speed registration 1 input	REG1
15	Common for registration	REG_COM
16	24V registration power	REG_24V
17	High speed registration 2 input	REG2
18	Common for registration	REG_COM
19	Reserved	—
20	Reserved	—
21	Reserved	—
22	Reserved	—
23	Analog output 0	DAC0
24	Analog output common	DAC_COM
25	Analog output 1	DAC1
26	Analog output common	DAC_COM

IMPORTANT Signals +24V_PWR and +24V_COM are a 24V dc source you can use only for the inputs listed above.

Pin Orientation for 26-pin I/O (IOD) Connector



Motor Feedback Connector Pinouts

Stegmann Hiperface (SRS/SRM)

MF Pin	Description	Signal
1	Sine differential input+	SINE+
2	Sine differential input-	SINE-
3	Cosine differential input+	COS+
4	Cosine differential input-	COS-
5	Hiperface data channel	DATA+
6	Common	ECOMM
7	Encoder power (+9V)	EPWR_9VM
8	Reserved	—
9	Reserved	—
10	Hiperface data channel	DATA-
11	Motor thermal switch (normally closed) (1)	TS
12	Reserved	—
13	Reserved	—
14	Encoder power (+5V)	EPWR_5VM
15	Reserved	—

(1) Not applicable unless motor has integrated thermal protection.

TTL or Sine/Cosine with Index Pulse and Hall Commutation

MF Pin	Description	Signal
1	AM+ / Sine differential input+	AM+ / SINE+
2	AM- / Sine differential input-	AM- / SINE-
3	BM+ / Cosine differential input+	BM+ / COS+
4	BM- / Cosine differential input-	BM- / COS-
5	Index pulse+	IM+
6	Common	ECOMM
7	Encoder power (+9V)	EPWR_9VM
8	Single-ended 5V hall effect commutation	S3
9	Reserved	—
10	Index pulse-	IM-
11	Motor thermal switch (normally closed) (1)	TS
12	Single-ended 5V hall effect commutation	S1
13	Single-ended 5V hall effect commutation	S2
14	Encoder power (+5V)	EPWR_5VM
15	Reserved	—

(1) Not applicable unless motor has integrated thermal protection.

Resolver Transmitter (transformation ratio = 0.25)

MF Pin	Description	Signal
1	Sine differential input+	S2
2	Sine differential input-	S4
3	Cosine differential input+	S1
4	Cosine differential input-	S3
5	Resolver excitation	R1
6	Common	ECOMM
7	Encoder power (+9V)	EPWR_9VM
8	Reserved	—

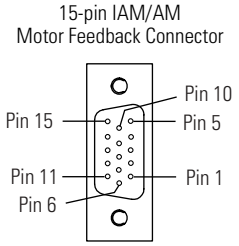
MF Pin	Description	Signal
9	Reserved	—
10	Resolver excitation	R2
11	Motor thermal switch (normally closed) (1) (2)	TS
12	Reserved	—
13	Reserved	—
14	Encoder power (+5V)	EPWR_5VM
15	Reserved	—

(1) Not applicable unless motor has integrated thermal protection.

(2) When using 1326AB (resolver-based) motors, use Low-profile Connector Kit (2090-K6CK-D15MF) that connects the filtered thermal switch (pins 16 and 17) to MF-11 and MF-6.

IMPORTANT To meet CE requirements, combined motor power cable length for all axes on the same dc bus must not exceed 240 m (787 ft) with 460V systems or 160 m (525 ft) with 230V systems. Drive-to-motor power cables must not exceed 90 m (295.5 ft).

Pin Orientation for 15-pin Motor Feedback (MF) Connector



Auxiliary Feedback Connector Pinouts

For TTL devices, the position count will increase when A leads B. For sinusoidal devices, the position count will increase when cosine leads sine.

Stegmann Hiperface (SRS and SRM only)

AF Pin	Description	Signal
1	Sine differential input+	SINE+
2	Sine differential input-	SINE-
3	Cosine differential input+	COS+
4	Cosine differential input-	COS-
5	Hiperface data channel	DATA+
6	Common	ECOM
7	Encoder power (+9V)	EPWR_9V
8	Reserved	—

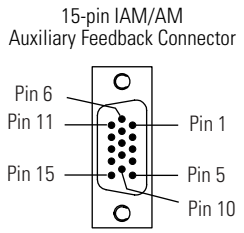
AF Pin	Description	Signal
9	Reserved	—
10	Hiperface data channel	DATA-
11	Reserved	—
12	Reserved	—
13	Reserved	—
14	Encoder power (+5V)	EPWR_5V
15	Reserved	—

TTL or Sine/Cosine with Index Pulse

AF Pin	Description	Signal
1	A+ / Sine differential input+	A+ / SINE+
2	A- / Sine differential input-	A- / SINE-
3	B+ / Cosine differential input+	B+ / COS+
4	B- / Cosine differential input-	B- / COS-
5	Index pulse+	I+
6	Common	ECOM
7	Encoder power (+9V)	EPWR_9V
8	Reserved	—

AF Pin	Description	Signal
9	Reserved	—
10	Index pulse-	I-
11	Reserved	—
12	Reserved	—
13	Reserved	—
14	Encoder power (+5V)	EPWR_5V
15	Reserved	—

Pin Orientation for 15-pin Auxiliary Feedback (AF) Connector



IAM Input Connector Pinouts

Control Power Connector

CPD Pin	Description	Signal
1	Control power VAC input	CTRL 2
2		CTRL 1

DC Bus and Input Power Connector

IPD Pin	Description	Signal
1	An integral, unregulated power supply, consisting of ac line input, three-phase bridge rectifier, and filter capacitors.	DC-
2		DC+
3	Chassis ground.	⏚
4	Three-phase input power.	L3
5		L2
6		L1

Contactor Enable Connector

CED Pin	Description	Signal
1	Relay-driven dry contact used in the safety string for a three-phase power contactor.	CONT EN-
2		CONT EN+

IAM and AM Motor Power and Brake Connector Pinouts

Motor Power Connector

MP Pin	Description	Signal
4	Chassis ground	⏚
3	Three-phase motor power	W
2		V
1		U

IMPORTANT To meet CE requirements, combined motor power cable length for all axes on the same dc bus must not exceed 240 m (787 ft) with 460V systems or 160 m (525 ft) with 230V systems. Drive-to-motor power cables must not exceed 90 m (295.5 ft).

Motor Brake/Resistive Brake Connector

BC Pin	Description	Signal
6	Motor brake connections	MBRK-
5		MBRK+
4	Motor brake common	COM
3	+24V brake input power (from LIM or customer supplied)	PWR
2	Resistive brake module (RBM) connections (from RBM and safety string)	DBRK-
1		DBRK+

Understanding IAM/AM Signal Specifications

A description of the Kinetix 6000 IAM/AM input/output (IOD), SERCOS, contactor enable (CED), brake (BC), and control power (CPD) connectors is provided on the following pages.

Digital Inputs

Two fast registration inputs and four other inputs are available for the machine interface on the integrated sxis module (IAM) and axis module (AM). Each IAM and AM supplies 24V dc @ 500 mA for the purpose of registration, home, enable, over-travel positive, and over-travel negative inputs. These are sinking inputs that require a sourcing device. A 24V power and common connection is provided for each input.

IMPORTANT To improve registration input EMC performance, refer to the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001.

IMPORTANT Overtravel limit input devices must be normally closed.

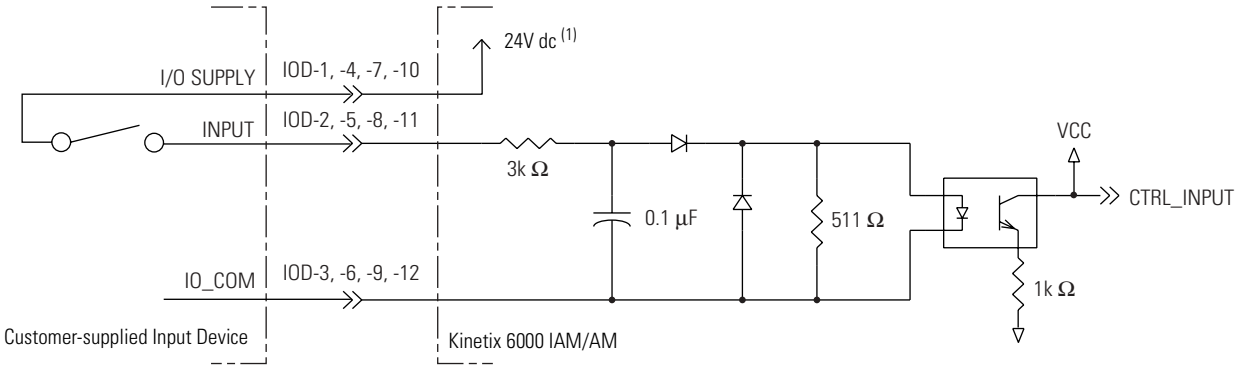
Understanding Digital Inputs

IOD Pin	Signal	Description	Capture Time	Edge/Level Sensitive
IOD-2	ENABLE	Optically isolated, single-ended active high signal. Current loading is nominally 10 mA. A 24V dc input is applied to this terminal to enable each axis.	20 ms	Level
IOD-5	HOME	Optically isolated, single-ended active high signal. Current loading is nominally 10 mA. Home switch (normally open contact) inputs for each axis require 24V dc (nominal).	20 ms	Level
IOD-14 IOD-17	REG1 REG2	Fast registration inputs are required to inform the motor interface to capture the positional information with less than 3 µs uncertainty. Optically isolated, single-ended active high signal. Current loading is nominally 10 mA. A 24V dc input is applied to this terminal to enable each axis.	500 ns	Edge
IOD-8 IOD-11	OT+ OT-	Overtravel detection is available as an optically isolated, single-ended active high signal. Current loading is nominally 10 mA per input. The pos/neg limit switch (normally closed contact) inputs for each axis require 24V dc (nominal).	20 ms	Level

Digital Input Specifications

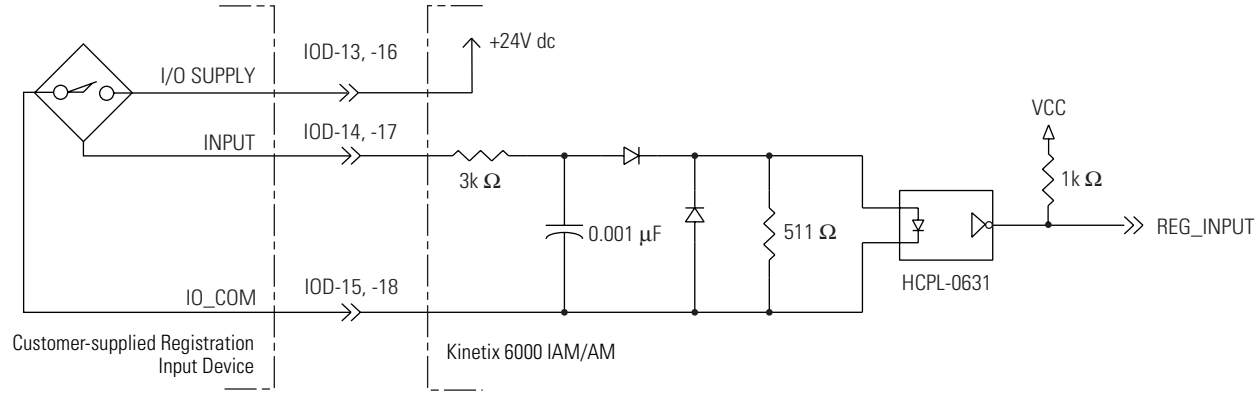
Parameter	Description		Min	Max
On-state voltage	Voltage applied to the input, with respect to IOCOM, to guarantee an on-state.	ENABLE, HOME, and OT+/OT-	10.8V	26.4V
		REG1 and REG2	21.6V	26.4V
On-state current	Current flow to guarantee an on-state.		3.0 mA	10.0 mA
Off-state voltage	Voltage applied to the input, with respect to IOCOM, to guarantee an off-state.		-1.0V	3.0V

Enable, Home, and Overtravel Digital Input Circuits



(1) 24V dc source (range) = 21.6V - 26.4V (supplied by drive, not to exceed 500 mA total). Maximum current input = 10 mA

Registration Digital Input Circuits



SERCOS Connections

Two fiber-optic connectors (transmit and receive) are provided on the integrated axis module (IAM) and axis module (AM).

SERCOS Communications Specifications

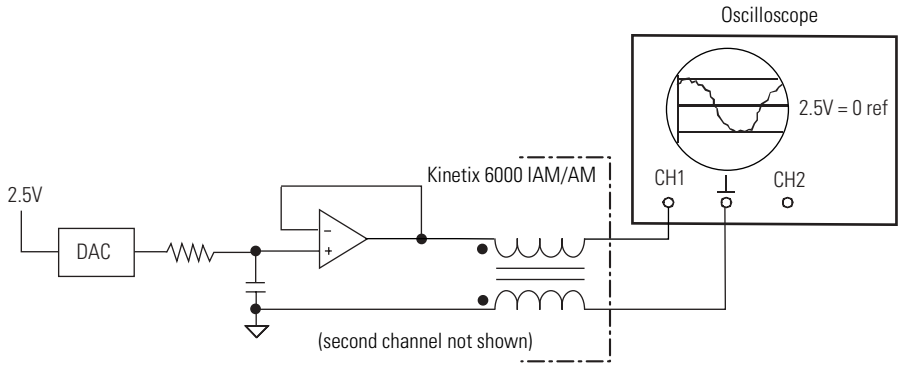
Specification	Description
Data Rates	2, 4, and 8 Mbps
Node Addresses	01...99 (1)

(1) Node address assignments begin with the integrated axis module (IAM). Node addresses for additional axes on the same power rail are assigned by incrementing from left to right (starting with the IAM address).

Analog Outputs

The integrated axis module (IAM) and axis module (AM) include two analog outputs (IOD-23 and -25) that can be configured through software to represent drive variables.

Analog Output Circuit



IMPORTANT Output values can vary during power-up until the specified power supply voltage is reached.

Analog Output Specifications

Parameter	Description	Min	Max
Resolution	Number of states that the output signal is divided into, which is 2 (to the number of bits).	—	±11 bits
Output current	Current capability of the output.	0	+2 mA
Output signal range	Range of the output voltage.	0	+5V
Offset error	Deviation when the output should be at 0V.	—	1 mV
Bandwidth	Frequency response of the analog output	dc	7.2k Hz (3 db)

For configuration/setup of the analog outputs, refer to Supplemental Troubleshooting Information beginning on page 160.

Contactor Enable Relay

Contactor enable is a relay-driven contact used in the safety control string to protect the drive electronics during certain fault conditions. It is capable of handling 120V ac or 24V dc at 1 A or less. Contactor enable is a function of the converter and is not available in the axis modules. An active state indicates the drive is operational and does not have a fault.

ATTENTION

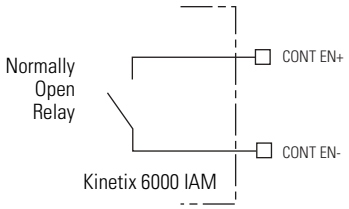
Wiring the contactor enable relay is required. To avoid personal injury or damage to the drive, wire the contactor enable relay into your safety control string so that:

- three-phase power is removed from the drive in the event of shutdown fault conditions.
- drive operation is prevented when the Power Rail is not fully populated.
- control power is applied to the drive prior to three-phase power.

Refer to IAM Wiring Example (without LIM) on page 196 for a wiring example.

IMPORTANT All power rail slots must have a module installed or the contactor enable relay will not close.

Contactor Enable Relay Circuit



Contactor Enable Relay Output Specifications

Parameter	Description	Min	Max
On-state current	Current flow when the relay is closed	—	1 A
On-state resistance	Contact resistance when the relay is closed	—	1 Ω
Off-state voltage	Voltage across the contacts when the relay is open	—	120V ac or 24V dc

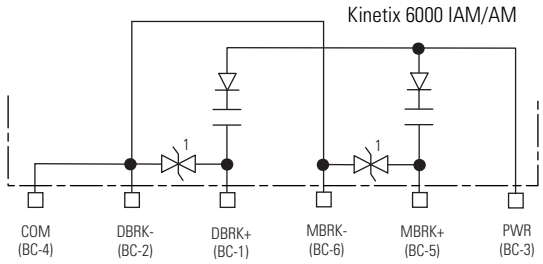
Motor/Resistive Brake Relay

Two connections are required for the (customer-supplied) motor/resistive brake input power (BC-3 and -4) and two connections each for the motor and resistive brake output, as shown in the figure below. Connections are rated for +24V and current as shown in the table below.

An active signal releases the motor brake (BC-5 and -6). The brake signal is the same as the contactor enable signal, with the addition of the turn-on and turn-off delays specified by the brake active delay and brake inactive delay (configurable in RSLogix 5000 software). Refer to Axis Module/Motor Wiring Examples beginning on page 204 and Controlling a Brake Example on page 210 for wiring examples.

The resistive brake relay (BC-1 and -2) controls the resistive brake module (RBM) contactor. The RBM is wired between the drive and motor, using an internal contactor to switch the motor between the drive and a resistive load. The RBM contact delay is the time it takes to fully close the contactor across the motor power input lines, and must be configured in RSLogix 5000 software. Refer to Integrating Resistive Brake Modules with Kinetix 6000 Drives beginning on page 239 for wiring examples.

Brake Relay Circuit



(1) Noise suppression device.

Brake Relay Output Specifications

Parameter	Description	IAM/AM	Max
On-state current (1)	Current flow when the relay is closed	2094-AC05-M*xx*, -AC09-M*xx*, 2094-AMP5, -AM01, -AM02	1.0 A
		2094-BC01-M*xx*, -BC02-M*xx*, 2094-BMP5, -BM01, -BM02	
		2094-AC16-M*xx*, -AC32-M*xx*, 2094-AM03, -AM05	1.3 A
		2094-BC04-M*xx*, -BC07-M*xx*, 2094-BM03, -BM05	3.0 A
On-state resistance	Contact resistance when the relay is closed		1 Ω
Off-state voltage	Voltage across the contacts when the relay is open		30V

(1) For motors requiring more than the maximum current specified, a relay must be added.

Control Power Input

The integrated axis module (IAM) requires ac input power for logic circuitry.

IMPORTANT The control power input requires an ac (EMC) line filter for CE certification. For wiring examples, refer to Power Wiring Examples beginning on page 193.

IMPORTANT Source 2094-AC*xx*-M*xx* (230V) IAM control power from the three-phase input power (line-to-line). Supplying 230V control power from any other source requires an isolation transformer. If used, do not ground either leg of the isolation transformer output. Control power isolation, via a step-down transformer, is required for all 460V applications.

Refer to Transformer Specifications for Control Power Input on page 179.

Control Power Current Specifications

Specification	Description
Input voltage	95...264V ac rms, single-phase
Input power frequency	47...63 Hz

Control Power Current Requirements

Number of Axis Modules (1)	Current Requirements (110/115V ac input)	Current Requirements (220/230V ac input)	Input VA
0	750 mA	350 mA	150 VA
1	1.5 A	700 mA	200 VA
2	2.25 A	1 A	275 VA
3	3 A	1.35 A	350 VA
4	3.75 A	1.7 A	450 VA
5	4.5 A	2 A	550 VA
6	5.25 A	2.4 A	650 VA
7	6 A	3 A	750 VA

(1) This number does not include the axis module (inverter section) that resides inside the integrated axis module.

Understanding Feedback Specifications

The integrated axis module (IAM) and axis module (AM) can accept motor and auxiliary feedback signals from the following types of encoders:

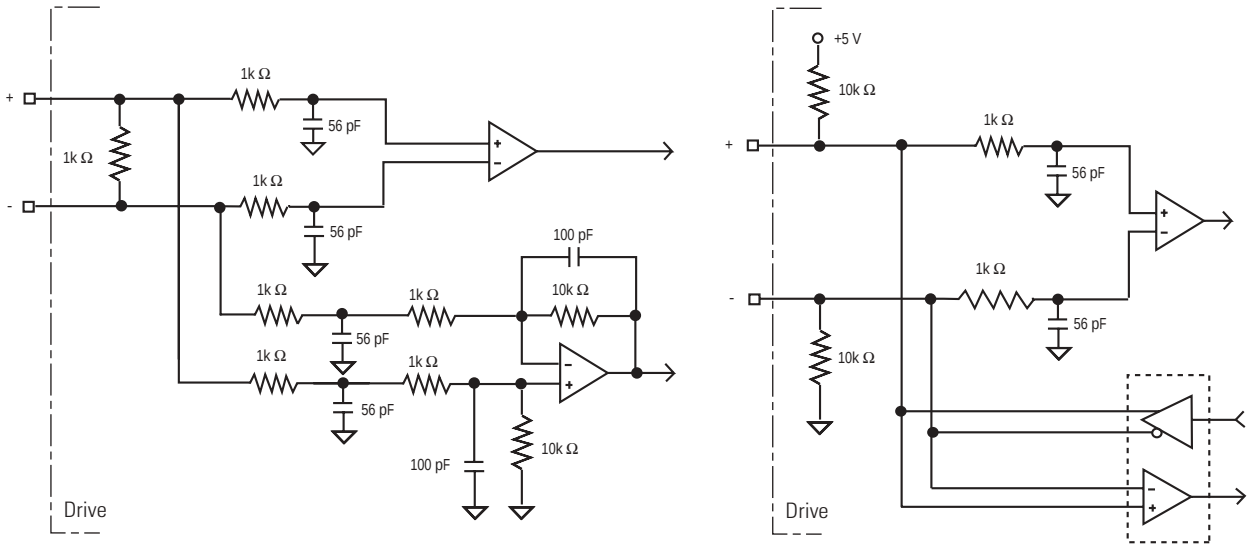
- Stegmann Hiperface
- TTL or Sine/Cosine with index pulse and Hall commutation
- Resolver Transmitter TR = 0.25 (motor feedback only)

TIP Auto-configuration in RSLogix 5000 software of intelligent absolute, high-resolution, and incremental encoders is possible only with Allen-Bradley motors.

Motor and Auxiliary Feedback Specifications

AM, BM, and IM input encoder signals are filtered using analog and digital filtering. The inputs also include illegal state change detection.

AM, BM, and IM Motor Encoder Input Circuits



AM and BM Channel Inputs

IM Channel Input

Motor Encoder Feedback Specifications

Specification	Description
Encoder types	Incremental, A quad B, sine/cosine, intelligent, resolver, and absolute
Maximum input frequency	5.0 MHz (TTL input) per channel
	250 kHz (sine/cosine input)
Commutation feedback	Hall sensor

AM, BM, and IM Input Specifications for TTL Encoders

Parameter	Description	Min	Max
AM, BM, and IM On-state input voltage	Input voltage difference between the plus (+) input and the minus (-) input that is detected as an on-state.	+1.0V	+7.0V
AM, BM, and IM Off-state input voltage	Input voltage difference between the plus (+) input and the minus (-) input that is detected as an off-state.	-1.0V	-7.0V
Common mode input voltage	Potential difference between any encoder signal and logic ground.	-7.0V	+12.0V
DC current draw	Current draw into the + or - input.	-30 mA	30 mA
AM, BM input signal frequency	Frequency of the AM or BM signal inputs. The count frequency is 4 times this frequency, since the circuitry counts all four transitions.	—	5.0 MHz
IM pulse width	Pulse width of the index input signal. Since the index is active for a percentage of a revolution, the speed will determine the pulse width.	125 nS	—
AM, BM phase error 2.5 MHz line frequency	Amount that the phase relationship between the AM and BM inputs can deviate from the nominal 90°.	-22.5°	+22.5°
AM, BM phase error 1 MHz line frequency	Amount that the phase relationship between the AM and BM inputs can deviate from the nominal 90°.	-45°	+45°

AM, BM, and IM Input Specifications for Sine/Cosine Encoders

Parameter	Description	Min	Max
Sine/cosine input signal frequency	Frequency of the Sine or Cosine signal inputs.	—	250 kHz
Sine/cosine input voltage	Peak-to-peak input voltages of the Sine or Cosine inputs.	0.5V (p-p)	2.0V (p-p)

Feedback Power Supply

The IAM and AM power circuit board generates +5V and +9V dc for motor and auxiliary feedback power. Short circuit protection and separate common mode filtering for each channel is included.

Motor and Auxiliary Feedback Power Specifications

Supply	Reference	Voltage			Current mA	
		Min	Nominal	Max	Min	Max
+5V dc	EPWR_5V	5.13	5.4	5.67	10	400 (1) (3)
+9V dc	EPWR_9V	8.3	9.1	9.9	10	275 (2) (3)

(1) 400 mA on the 5V supply split in any manner between the channels with no load on the 5V supply.

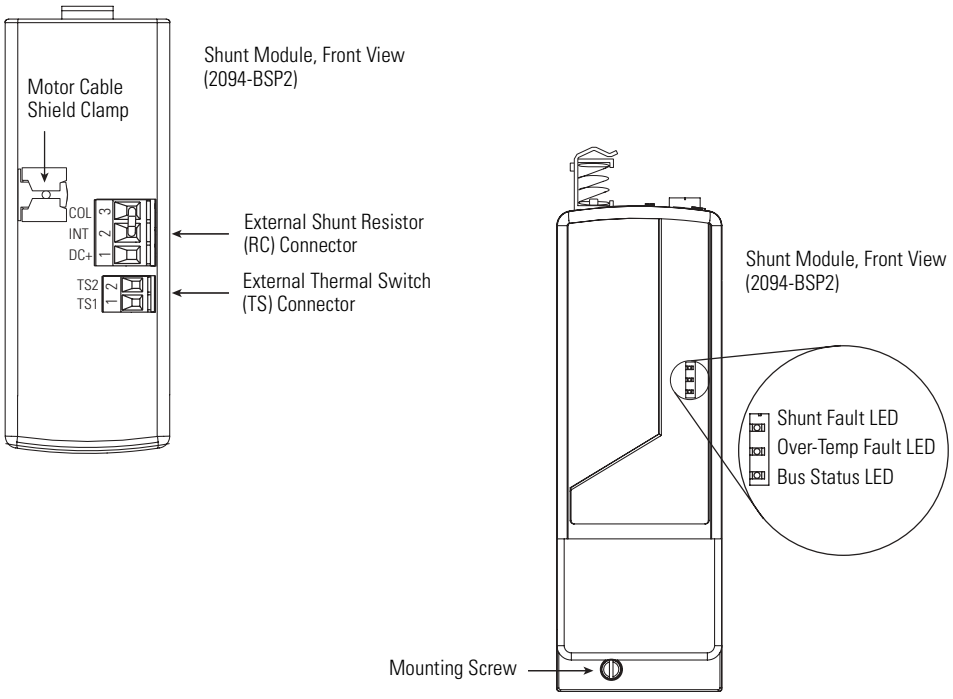
(2) 275 mA on the 9V supply split in any manner between the channels with no load on the 9V supply.

(3) 300 mA on the 5V supply on one channel with 150 mA on the 9V supply on the second channel.

Locating Shunt Module Connectors and Indicators

The Kinetix 6000 shunt module (2094-BSP2) is suitable for both 230V and 460V applications.

Locating Shunt Module Connectors and Indicators



Shunt Module Connectors

Designator	Description	Connector
RC	External shunt resistor connector	Three-position connector housing
TS	Thermal switch connector	Two-position connector housing

External Shunt Resistor Three-pin (RC) Connector Pinout

RC Pin	Description	Signal
1	External shunt resistor connection	DC+
2	Internal shunt connection	INT
3	Shunt collector connection	COL

External Thermal Switch Two-pin (TS) Connector Pinout

TS Pin	Description	Signal
1	External passive shunt module thermal switch connections	TS1
2		TS2

Refer to Understanding External Shunt Module Connections on page 113 when wiring the RC and TS connectors.

Connecting the Kinetix 6000 Drive System

Introduction

This chapter provides procedures for wiring your Kinetix 6000 system components and making cable connections.

Understanding Basic Wiring Requirements

This section contains basic wiring information for the Kinetix 6000 drive.

ATTENTION

Plan the installation of your system so that you can perform all cutting, drilling, tapping, and welding with the system removed from the enclosure. Because the system is of the open type construction, be careful to keep any metal debris from falling into it. Metal debris or other foreign matter can become lodged in the circuitry, which can result in damage to components.

SHOCK HAZARD

To avoid hazard of electrical shock, perform all mounting and wiring of IAM, AM, SM, LIM, RBM, or power rail prior to applying power. Once power is applied, connector terminals may have voltage present even when not in use.

IMPORTANT This section contains common PWM servo system wiring configurations, size, and practices that can be used in a majority of applications. National Electrical Code, local electrical codes, special operating temperatures, duty cycles, or system configurations take precedence over the values and methods provided.

Building Your Own Cables

IMPORTANT Factory-made cables are designed to minimize EMI and are recommended over hand-built cables to optimize system performance.

- Connect the cable shield to the connector shells on both ends of the cable with a complete 360° connection.
- Use a twisted pair cable whenever possible. Twist differential signals with each other and twist single-ended signals with the appropriate ground return.

Refer to the Kinetix Motion Control Selection Guide, publication GMC-SG001 for low profile connector kit, drive-end (mating) connector kit, and motor-end connector kit catalog numbers.

Routing Power and Signal Wiring

Be aware that when you route power and signal wiring on a machine or system, radiated noise from nearby relays, transformers, and other electronic drives can be induced into motor or encoder feedback signals, input/output communications, or other sensitive low voltage signals. This can cause system faults and communication problems.

Refer to Minimizing Electrical Noise on page 27 for examples of routing high and low voltage cables in wireways. Refer to the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001, for more information.

Determining Your Type of Input Power

Before wiring input power to your Kinetix 6000 system, you must determine the type of input power you are connecting to. The IAM is designed to operate in both grounded and ungrounded environments.

ATTENTION

When using a LIM with your Kinetix 6000 drive, the VAC LINE input power must come from a grounded configuration (refer to the figure below).

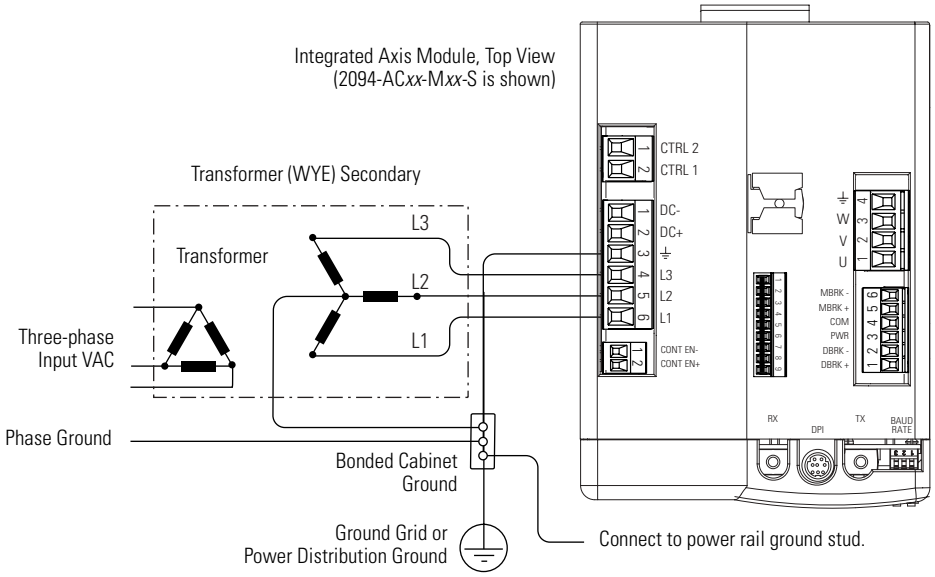
When not using a LIM with your Kinetix 6000 drive, ungrounded configurations are permitted, but you must set the jumper to prevent high electrostatic build-up.

Refer to Setting the Ground Jumper in Ungrounded Power Configurations on page 75 for more information.

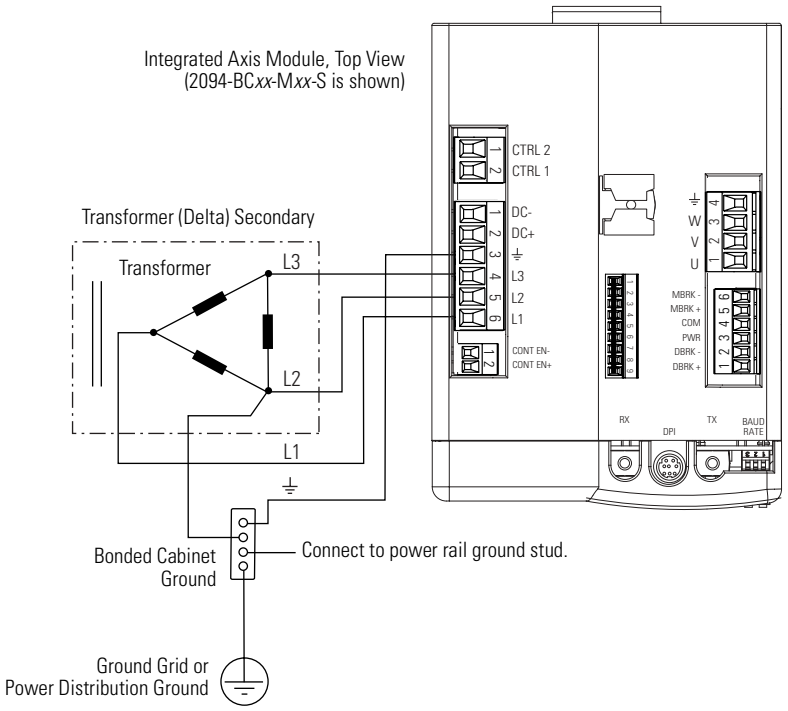
Grounded Power Configurations

The grounded (WYE) power configuration lets you ground your three-phase power at a neutral point. This type of grounded power configuration is preferred.

Grounded Power Configuration (WYE Secondary)



Grounded (B-Phase) Power Configuration (Delta Secondary)



The integrated axis module (IAM) has a factory-installed ground jumper configured for grounded power distribution.

IMPORTANT If you determine that you have grounded power distribution in your plant, you do not need to modify your IAM.

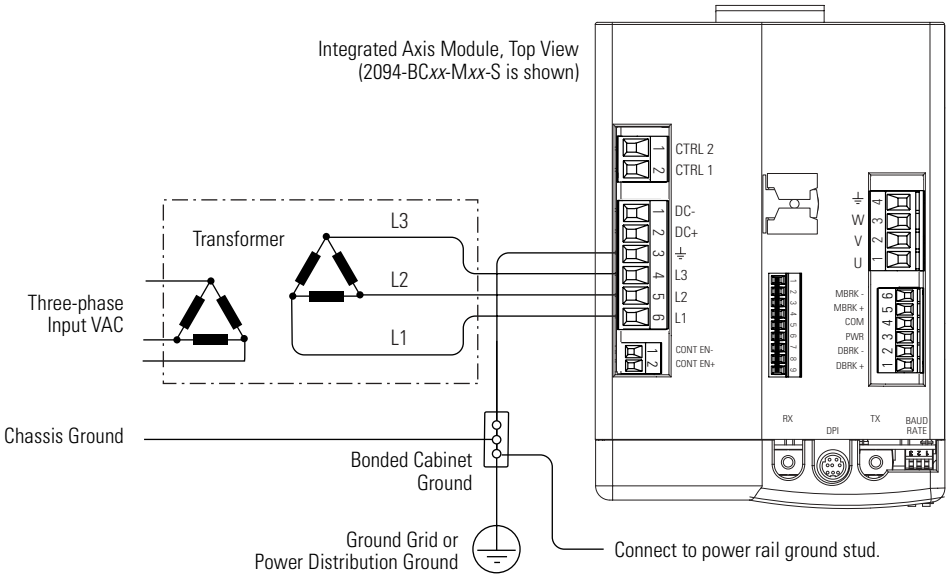
Ungrounded Power Configurations

Ungrounded power configurations are allowed, but you must jumper across a 120 kΩ resistor (internal to the IAM) to prevent high electrostatic build-up. The ungrounded power configuration (shown below) does not provide a neutral ground point. The IAM has a ground jumper set for grounded power distribution (default configuration).

IMPORTANT If you determine that you have ungrounded power distribution in your facility, you need to move the default jumper (configured for grounded power) to the ungrounded power position to prevent electrostatic buildup inside the IAM.

Refer to Setting the Ground Jumper in Ungrounded Power Configurations on page 75 for more information.

Ungrounded Power Configuration



ATTENTION Ungrounded systems do not reference each phase potential to a power distribution ground. This can result in an unknown potential to earth ground.

DC Common Bus Configurations

When an integrated axis module (IAM) is used in a dc common bus configuration, the IAM is known as a leader IAM or follower IAM. The IAM (non-common bus) and leader IAM have identical three-phase input power connections. The leader IAM is responsible for discharging the dc bus, and for providing common bus follower drives with dc bus pre-charge, bus regulation, phase-loss detection, and ground fault detection. Follower IAMs do not have three-phase input power connections, but have dc bus connections from a leader IAM.

IAM Terminology and Use

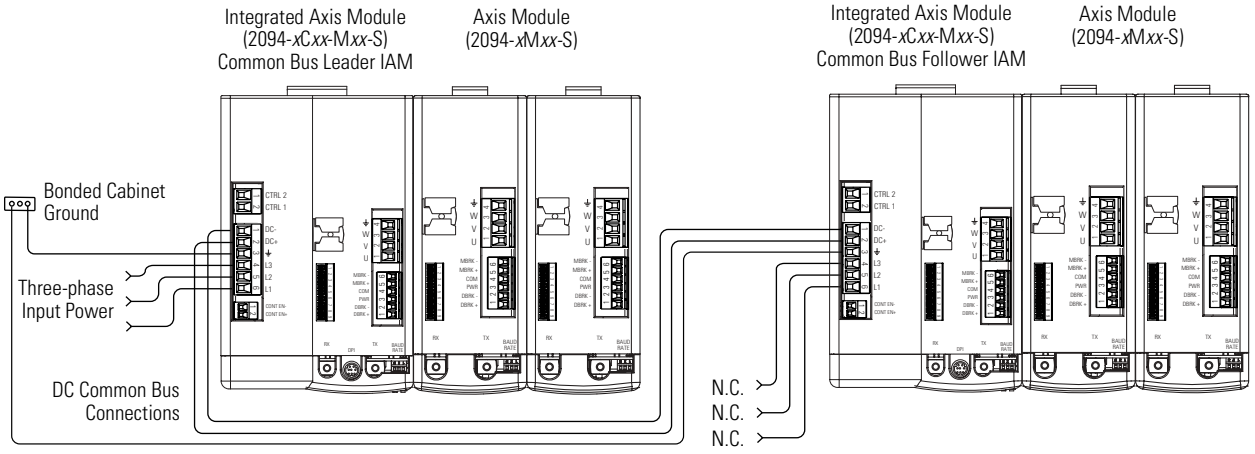
This IAM	Is Wired	And is
IAM	With three-phase input power.	Not wired in common bus mode.
Leader IAM	With three-phase input power, but has dc common bus connections to a follower IAM.	Wired in common bus mode.
Follower IAM	Without three-phase input power, but has dc common bus connections from a leader IAM.	Wired in common bus mode and configured using RSLogix 5000 software.

IMPORTANT Use Kinetix 6000 drive firmware v1.85 and RSLogix 5000 software v15 or later, for dc common bus power configurations.

The Kinetix 6000 leader IAM can operate with non-Kinetix 6000 follower drives, as can the Kinetix 6000 follower IAM operate with non-Kinetix 6000 common bus leader drives. However, non-Kinetix 6000 leader and follower drives must meet the same functional requirements as the Kinetix 6000 leader and follower IAMs.

IMPORTANT Any non-Kinetix 6000 common bus leader that does not provide pre-charge is required to add an additional external pre-charge circuit before connecting to any Kinetix 6000 common bus follower IAM.

Typical DC Common Bus Configuration



Common Bus Fusing Requirements

When using a Kinetix 6000 leader IAM, dc bus fuses are only required when wiring to more than one Kinetix 6000 follower IAM. When wiring multiple follower IAMs, terminal blocks are required to extend the dc common bus power to additional drives. Fuses should be installed in both lines of the dc bus between the dc bus terminal block and each follower IAM. These fuses should be rated based on the dc input current of each follower IAM.

When using a non-Kinetix 6000 common bus leader, dc bus fuses are required in both lines of the dc bus, between the common bus leader and follower IAM. These fuses should be rated based on the leader's dc output current. When using more than one follower IAM, fuses should be installed in both lines of the dc bus between the non-Kinetix 6000 common bus leader and the terminal block as well as between the dc bus terminal block and each follower IAM.

Refer to Circuit Breaker/Fuse Specifications on page 177 for recommended fuse sizes. Refer to DC Common Bus Wiring Examples on page 197 for interconnect diagrams.

Setting the Ground Jumper in Ungrounded Power Configurations

Setting the ground jumper is only necessary when using an ungrounded power configuration. Setting the jumper involves removing the IAM from the power rail, opening the IAM, and moving the jumper.

Setting the ground jumper is best done when the integrated axis module (IAM) is removed from the power rail and placed face-up on a solid surface equipped as a grounded static safe workstation.

ATTENTION

To avoid personal injury and/or equipment damage, remove the IAM from the power rail before setting the ground jumper.

To remove the IAM from the power rail, refer to Removing Power Rail Modules on page 164.

IMPORTANT If you have grounded power distribution, you do not need to set the ground jumper. Go to Grounding Your Kinetix 6000 System on page 78.

When using ungrounded input power in common bus configurations, use the table below to determine where to set the ground jumper.

Ground Jumper to Set

When Leader Drive is	And Follower Drive is	Then Set the Jumper in This Drive
Kinetix 6000 IAM	Kinetix 6000 IAM	Leader Drive.
Kinetix 6000 IAM	non-Kinetix 6000 IAM	Leader Drive.
non-Kinetix 6000 IAM	Kinetix 6000 IAM	Follower Drive (if no setting exists in the leader drive).

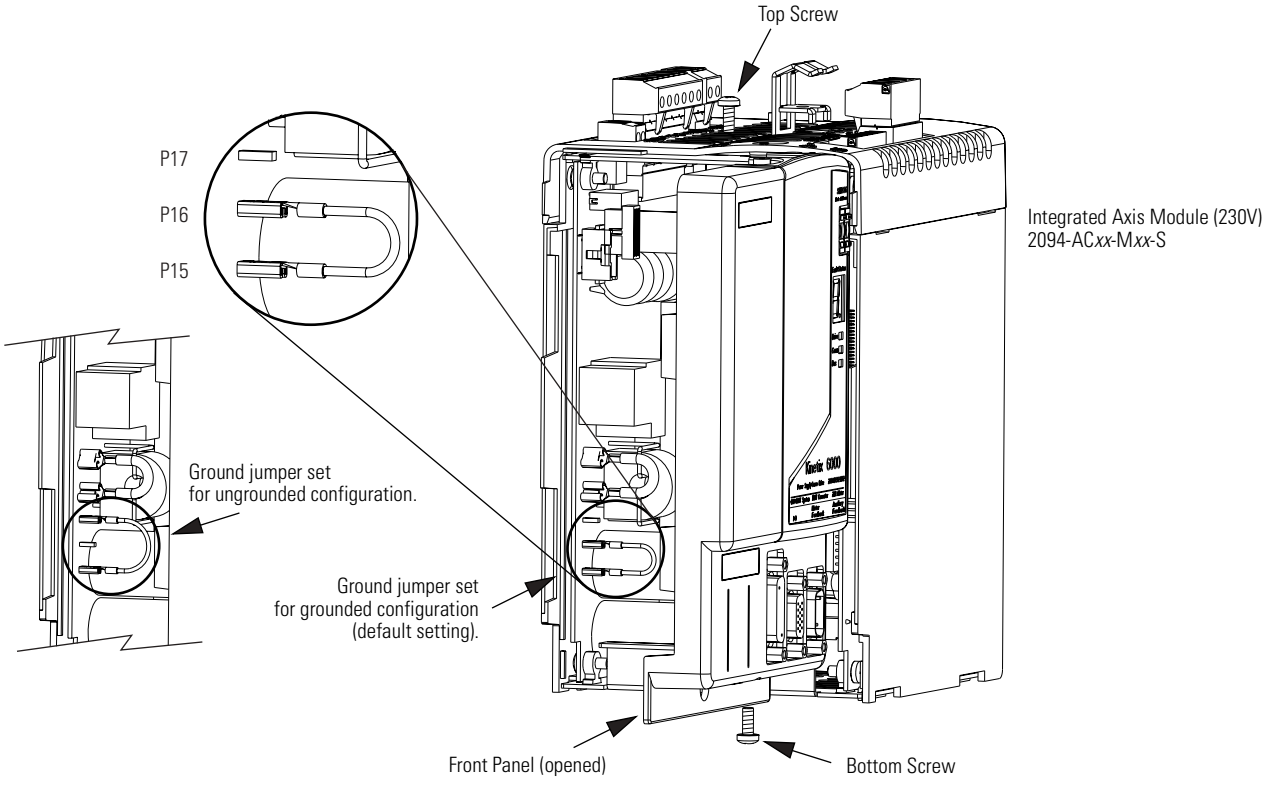
Setting the Ground Jumper

Follow these steps to set the ground jumper.

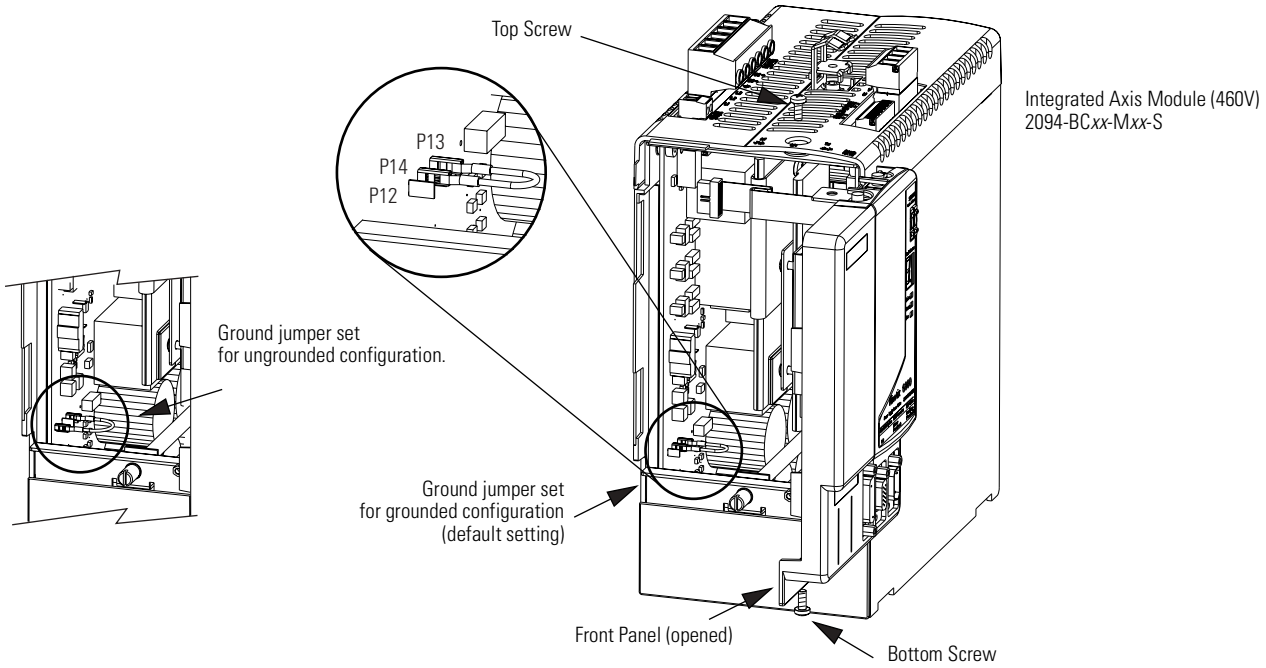
1. Remove the top and bottom front panel screws.

   Refer to the appropriate figure for your 230V or 460V IAM.

Setting the Ground Jumper (230V IAM)



Setting the Ground Jumper (460V IAM)



2. Swing the front panel open to the right, as shown, and locate the ground jumper.

IMPORTANT Do not attempt to remove the front panel from the IAM. The front panel LEDs and switches are also connected to the IAM with a ribbon cable. The ribbon cable will act like a hinge and allow you to swing the front panel open and access the ground jumper.

3. Determine if you have a 230V system or 460V system.

For This IAM	Move the Ground Jumper From
2094-AC*xx*-M*xx*-S (230V)	P16 to P17
2094-BC*xx*-M*xx*-S (460V)	P14 to P12

4. Replace the IAM front panel and two screws.

   Apply 1.6 Nm (14 lb-in) torque.

5. Mount the IAM back on the power rail.

   Refer to Mounting the Modules on page 45 for instructions.

Grounding Your Kinetix 6000 System

All equipment and components of a machine or process system should have a common earth ground point connected to chassis. A grounded system provides a ground path for short circuit protection. Grounding your modules and panels minimize shock hazard to personnel and damage to equipment caused by short circuits, transient overvoltages, and accidental connection of energized conductors to the equipment chassis.

ATTENTION

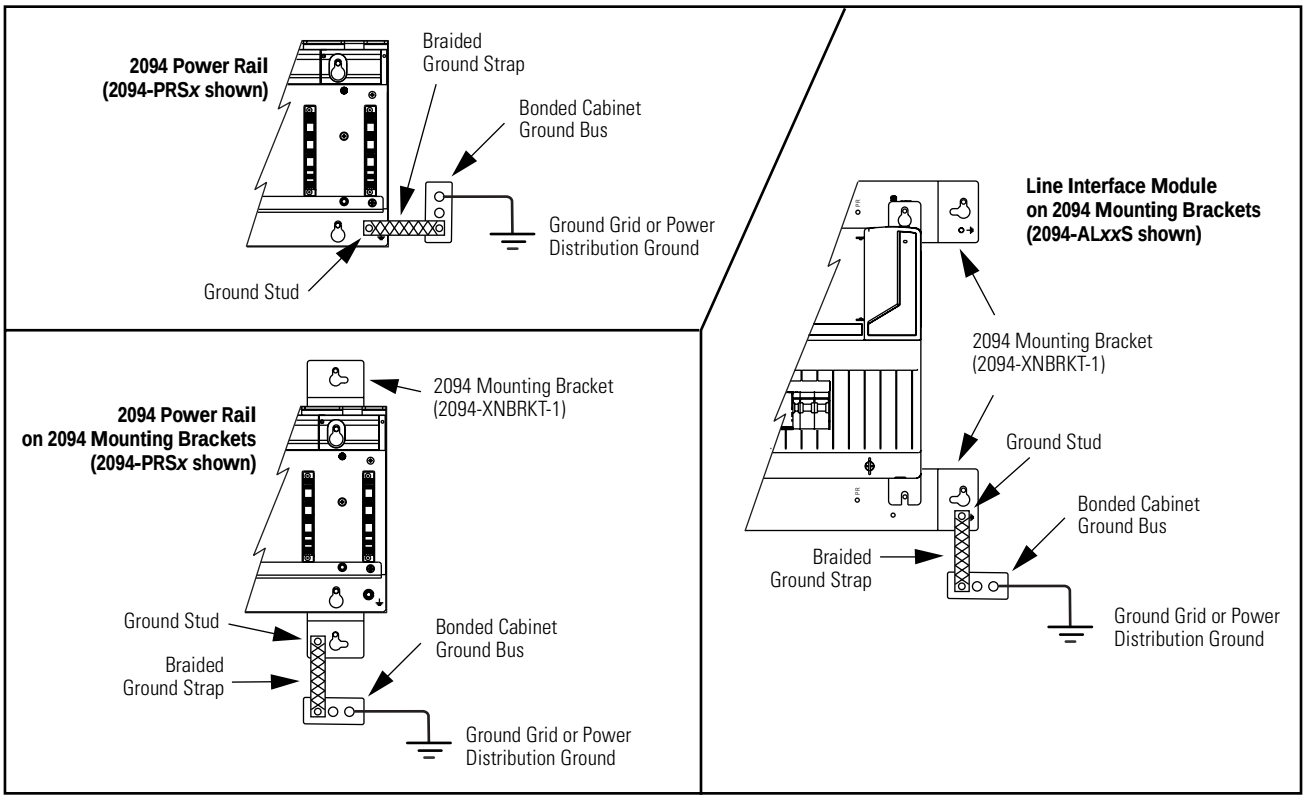
The National Electrical Code contains grounding requirements, conventions, and definitions. Follow all applicable local codes and regulations to safely ground your system.

For CE grounding requirements, refer to Agency Compliance on page 16.

Grounding Your System to the Subpanel

The 2094 power rail (2094-PR*x* or 2094-PRS*x*) ships with a braided ground strap, 100 mm (3.9 in.), that connects to the bonded cabinet ground bus. Connect the other end to either the power rail ground stud or mounting bracket ground stud, if mounting brackets are used.

Connecting the Braided Ground Strap Examples



For power rail dimensions, refer to the Kinetix 6000 Power Rail Installation Instructions, publication 2094-IN003.

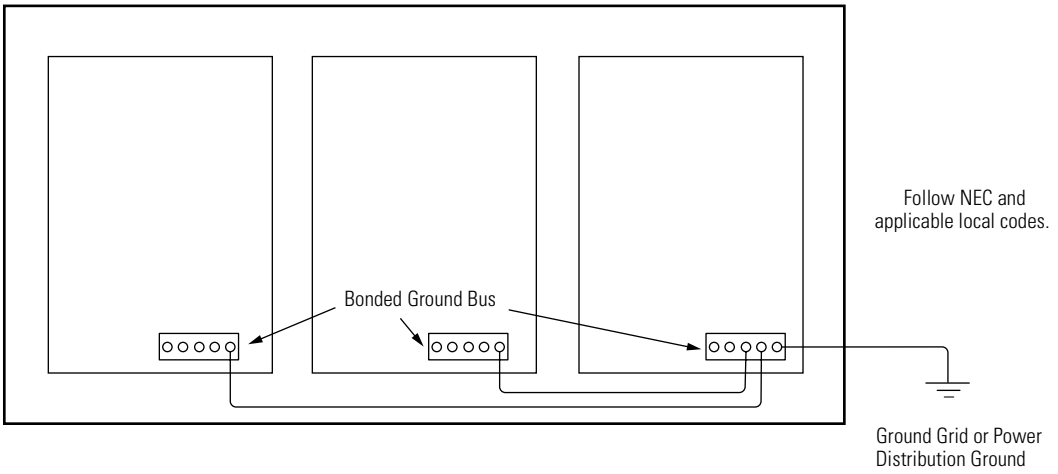
For mounting bracket dimensions, refer to the 2094 Mounting Brackets Installation Instructions, publication 2094-IN008.

IMPORTANT When 2094 mounting brackets are used to mount the power rail or LIM over the ac line filter, the braided ground strap must be removed from the power rail and attached to a mounting bracket ground stud.

Grounding Multiple Subpanels

Extending the chassis ground to multiple subpanels is illustrated in the figure below. High-frequency (HF) bonding is not illustrated.

Subpanels Connected to a Single Ground Point



For HF bonding information, refer to Bonding Multiple Subpanels on page 29.

Power Wiring Requirements

Wire should be copper with 75 °C (167 °F) minimum rating. Phasing of main ac power is arbitrary and earth ground connection is required for safe and proper operation.

IMPORTANT The National Electrical Code and local electrical codes take precedence over the values and methods provided.

IAM Power Wiring Requirements

Module	Catalog Number	Description	Connects to Terminals		Recommended Wire Size mm² (AWG)	Strip Length mm (in.)	Torque Value Nm (lb-in)
			Pin	Signal			
IAM (230V)	2094-AC05-M*xx*-S 2094-AC09-M*xx*-S	DC bus [1] and VAC input power	IPD-1 IPD-2 IPD-3 IPD-4 IPD-5 IPD-6	DC- DC+ ⏚ L3 L2 L1	2.5 (14)	10 (0.38)	0.5 - 0.6 (4.4 - 5.3)
	2094-AC16-M*xx*-S				10 (8)	16 (0.63)	2.4 - 3.0 (21.6 - 26.5)
	2094-AC32-M*xx*-S				25 (4)		
IAM (460V)	2094-BC01-M*xx*-S 2094-BC02-M*xx*-S				4.0 (12)	10 (0.38)	1.2 - 1.5 (10.6 - 13.2)
	2094-BC04-M*xx*-S				10 (8)	16 (0.63)	2.4 - 3.0 (21.6 - 26.5)
	2094-BC07-M*xx*-S				25 (4)		
IAM (230V or 460V)	2094-*xCxx*-M*xx*-S	Control input power	CPD-1	CTRL 2	2.5 (14)	10 (0.38)	0.5 - 0.6 (4.4 - 5.3)
			CPD-2	CTRL 1			
		Contactor Enable	CED-1	CONT EN-	2.5 (14) [2]		0.5 - 0.6 (4.4 - 5.3)
			CED-2	CONT EN+			

(1) DC common bus connections (leader IAM to follower IAM) should be kept as short as possible.

(2) The actual gauge of the contactor enable wiring depends on the system configuration. Consult your machine builder, the NEC, and applicable local codes.

ATTENTION

To avoid personal injury and/or equipment damage, make sure installation complies with specifications regarding wire types, conductor sizes, branch circuit protection, and disconnect devices. The National Electrical Code (NEC) and local codes outline provisions for safely installing electrical equipment.

To avoid personal injury and/or equipment damage, make sure motor power connectors are used for connection purposes only. Do not use them to turn the unit on and off.

To avoid personal injury and/or equipment damage, make sure shielded power cables are grounded to prevent potentially high voltages on the shield.

IAM/AM Power Wiring Requirements

Module	Catalog Number	Description	Connects to Terminals		Recommended Wire Size mm² (AWG)	Strip Length mm (in.)	Torque Value Nm (lb-in)
			Pin	Signal			
IAM or AM	2094-AC05-M*xx*-S 2094-AC09-M*xx*-S 2094-BC01-M*xx*-S 2094-BC02-M*xx*-S 2094-AMP5-S, -AM01-S, -AM02-S, -BMP5-S, -BM01-S, and -BM02-S	Motor power	MP-4 MP-3 MP-2 MP-1	⏚ W V U	Motor power cable depends on motor/drive combination. 6 (10) max	10 (0.38)	0.5 - 0.6 (4.4 - 5.3)
	2094-AC16-M*xx*-S 2094-AC32-M*xx*-S 2094-AM03-S, -AM05-S					10 (0.38)	1.2 - 1.5 (10.6 - 13.2)
	2094-BC04-M*xx*-S 2094-BC07-M*xx*-S 2094-BM03-S, -BM05-S				25 (4) max	16 (0.63)	2.4 - 3.0 (21.6 - 26.5)
	IAM or AM (230 or 460V) 2094-*x*C*xx*-M*xx*-S and 2094-*x*M*xx*-S	Brake power	BC-6 BC-5 BC-4 BC-3 BC-2 BC-1	MBRK- MBRK+ COM PWR DBRK- DBRK+	0.75 (18)	10 (0.38)	0.22 - 0.25 (1.9 - 2.2)
	IAM or AM (230 or 460V) 2094-*x*C*xx*-M*xx*-S and 2094-*x*M*xx*-S	Safe-off	SO-1 SO-2 SO-3 SO-4 SO-5 SO-6 SO-7 SO-8 SO-9	FDBK2+ FDBK2- FDBK1+ FDBK1- SAFETY ENABLE2+ SAFETY ENABLE- SAFETY ENABLE1+ 24V + 24V_COM	0.75 (18) (stranded wire with ferrule) 1.5 (16) (solid wire)	7.0 (0.275)	0.235 (2.0)

Shunt Module Power Wiring Requirements

Module	Description	Connects to Terminals		Recommended Wire Size mm² (AWG)	Torque Value Nm (lb-in)
		Pin	Signal		
SM (230/460V) 2094-BSP2	1394-SR-*xxxx* External passive shunt module	RC-1	DC+	10 (8) [1]	1.2 - 1.5 (10.6 - 13.2)
		RC-2	INT		
		RC-3	COL		
	Thermal switch	TS-1	TS1	0.75 (18)	0.22 - 0.25 (1.9 - 2.2)
		TS-2	TS2		

(1) 105 °C (221 °F), 600V.

Refer to Power Specifications on page 170 for additional information. Refer to Power Wiring Examples on page 193 for interconnect diagrams.

ATTENTION

This drive contains ESD (Electrostatic Discharge) sensitive parts and assemblies. You are required to follow static control precautions when you install, test, service, or repair this assembly. If you do not follow ESD control procedures, components can be damaged. If you are not familiar with static control procedures, refer to Allen-Bradley publication 8000-4.5.2, Guarding Against Electrostatic Damage or any other applicable ESD Protection Handbook.

ATTENTION

To avoid personal injury and/or equipment damage, ensure installation complies with specifications regarding wire types, conductor sizes, branch circuit protection, and disconnect devices. The National Electrical Code (NEC) and local codes outline provisions for safely installing electrical equipment.

To avoid personal injury and/or equipment damage, ensure motor power connectors are used for connection purposes only. Do not use them to turn the unit on and off.

To avoid personal injury and/or equipment damage, ensure shielded power cables are grounded to prevent potentially high voltages on the shield.

Wiring Guidelines

Use these guidelines as a reference when wiring the connectors on your Kinetix 6000 drive modules or line interface module (LIM).

IMPORTANT Refer to page 50 for the connector locations of the Kinetix 6000 drive modules.

When tightening screws to secure the wires, refer to the tables beginning on page 80 for torque values.

When removing insulation from wires, refer to the tables beginning on page 80 for strip lengths.

IMPORTANT To ensure system performance, run wires and cables in the wireways as established in Establishing Noise Zones on page 30.

Refer to the Line Interface Module Installation Instructions, publication 2094-IN005, for LIM power wiring requirements and connector locations. Refer to Wiring Examples beginning on page 192 for interconnect diagrams including the LIM.

Follow these steps when wiring the connectors on your Kinetix 6000 drive modules or line interface module (LIM).

1. Prepare the wires for attachment to each connector plug by removing insulation equal to the recommended strip length.

   IMPORTANT Use caution not to nick, cut, or otherwise damage strands as you remove the insulation.

2. Route the cable/wires to your Kinetix 6000 drive module or LIM.
3. Insert wires into connector plugs.

   Refer to connector pinout tables in Chapter 4 or the interconnect diagrams in Appendix B.

4. Tighten the connector screws.
5. Gently pull on each wire to make sure it does not come out of its terminal. Re-insert and tighten any loose wires.
6. Insert the connector plug into the module connector.

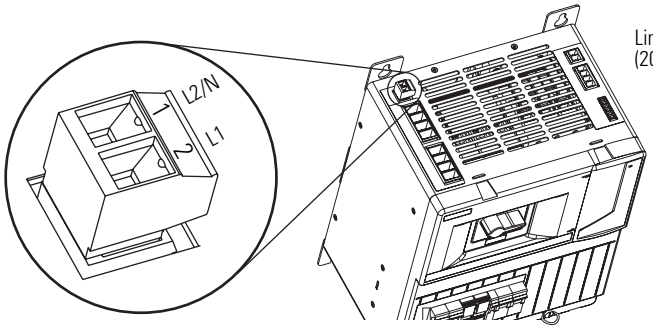
Wiring the LIM Connectors

This section provides examples and wiring tables to assist you in making connections to the line interface module (LIM) connectors.

Wiring the Auxiliary Input Power (APL) Connector

The Auxiliary Input Power (APL) connector is present only on the 2094-XL75S-C*x* models.

Line Interface Module (APL connector)



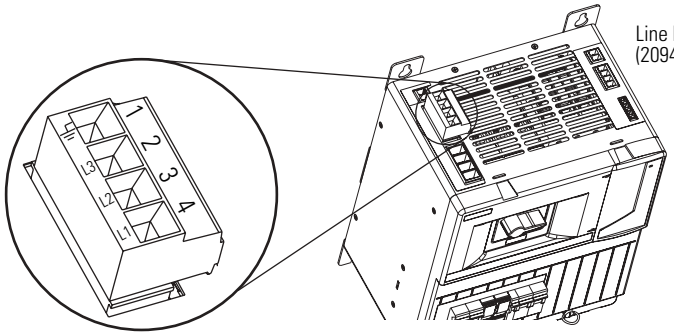
Line Interface Module, Top View
(2094-XL75S-C*x* is shown)

Auxiliary Input Power (APL) Connector

Single-phase Supply	APL Pin	Signal	Recommended Wire Size mm^2 (AWG)	Strip Length mm (in.)	Torque Value Nm (lb-in)
L1	1	L1	0.2-4.0 (24-10)	7.0 (0.28)	0.5 - 0.6 (4.4 - 5.3)
L2	2	L2/N			

Wiring the VAC LINE (IPL) Connector

Line Interface Module (IPL connector)



Line Interface Module, Top View
(2094-XL75S-C*x* is shown)

VAC LINE (IPL) Connector
2094-AL09, -AL*xx*S, -BL*xx*S, and -XL75S-C*x*

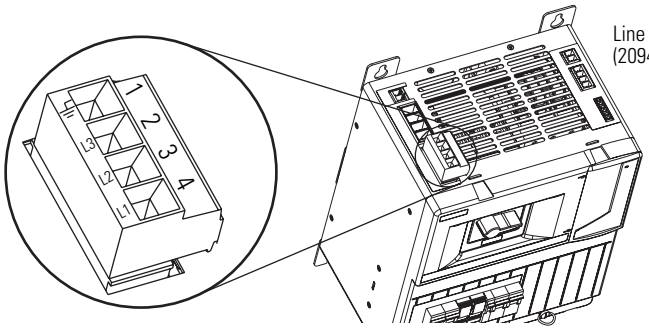
Three-phase Supply	IPL Pin	Signal	Recommended Wire Size mm² (AWG)	Strip Length mm (in.)	Torque Value Nm (lb-in)
L1	4	L1	2.5-25 (14-4)	16.0 (0.63)	2.7 (24)
L2	3	L2			
L3	2	L3			
⏚	1	⏚			

VAC LINE (IPL) Connector
2094-BL02

Three-phase Supply	IPL Pin	Signal	Recommended Wire Size mm² (AWG)	Strip Length mm (in.)	Torque Value Nm (lb-in)
L1	1	L1	4.0 (12)	10.0 (0.38)	1.5 - 1.8 (13.2 - 15.9)
L2	2	L2			
L3	3	L3			
⏚	4	⏚			

Wiring the VAC LOAD (OPL) Connector

Line Interface Module (OPL connector)



Line Interface Module, Top View
(2094-XL75S-C*x* is shown)

IMPORTANT Line interface modules (2094-AL*xx*S, -BL*xx*S, and -XL75S-C*x*) are capable of connecting to two IAMs, providing each IAM has its own line filter and the maximum current specification is not exceeded.

Refer to Power Wiring Examples on page 194 for an example of the LIM wired to two IAMs.

VAC LOAD (OPL) Connector (2094-AL*xx*S, -BL*xx*S, or -XL75S-C*x*)

Three-phase Supply	OPL Pin	Signal	Recommended Wire Size mm² (AWG)	Strip Length mm (in.)	Torque Value Nm (lb-in)
L1	4	L1'	2.5-25 (14-4)	16.0 (0.63)	2.7 (24)
L2	3	L2'			
L3	2	L3'			
⏚	1	⏚			

VAC LOAD (OPL) Connector (2094-AL09)

Three-phase Supply	OPL Pin	Signal	Recommended Wire Size mm² (AWG)	Strip Length mm (in.)	Torque Value Nm (lb-in)
L1	1	L1'	2.5-25 (14-4)	16.0 (0.63)	2.7 (24)
L2	2	L2'			
L3	3	L3'			
⏚	4	⏚			

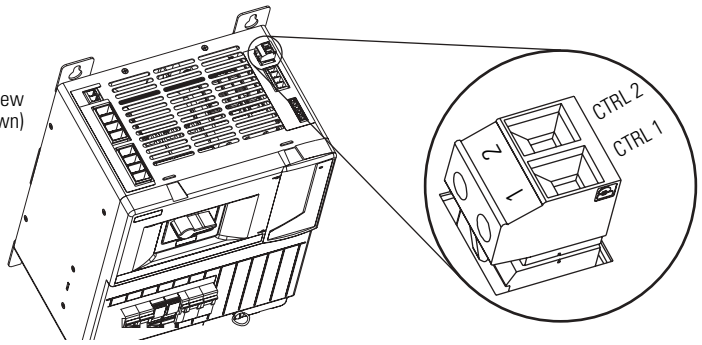
VAC LOAD (OPL) Connector (2094-BL02)

Three-phase Supply	OPL Pin	Signal	Recommended Wire Size mm² (AWG)	Strip Length mm (in.)	Torque Value Nm (lb-in)
L1	4	L1'	4.0 (12)	10.0 (0.38)	1.5 - 1.8 (13.2 - 15.9)
L2	3	L2'			
L3	2	L3'			
⏚	1	⏚			

Wiring the Control Power Output (CPL) Connector

Line Interface Module (CPL connector)

Line Interface Module, Top View
(2094-XL75S-C*x* is shown)



Control Power Output (CPL) Connector 2094-AL*xx*S, -BL*xx*S, -XL75S-C*x*

CPL Pin	Signal	Recommended Wire Size mm^2 (AWG)	Strip Length mm (in.)	Torque Value Nm (lb-in)
1	CTRL 1	0.2-4.0 (24-10)	7.0 (0.28)	0.5 - 0.6 (4.4 - 5.3)
2	CTRL 2			

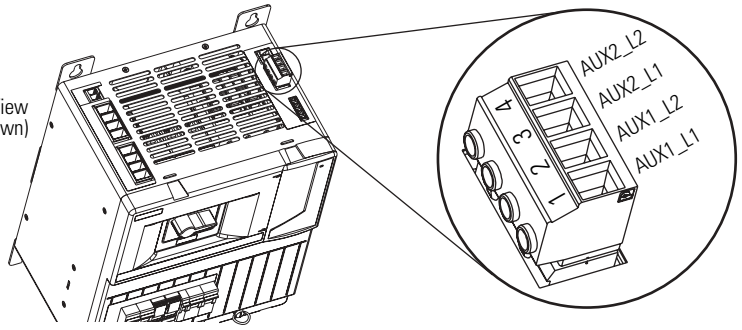
Control Power Output (CPL) Connector 2094-AL09 and -BL02

CPL Pin	Signal	Recommended Wire Size mm^2 (AWG)	Strip Length mm (in.)	Torque Value Nm (lb-in)
2	L1	2.5 (14)	10.0 (0.38)	0.5 - 0.6 (4.4 - 5.3)
1	L2/N			

Wiring the Auxiliary Power Output (P2L) Connector

Line Interface Module (P2L connector)

Line Interface Module, Top View
(2094-XL75S-C*x* is shown)



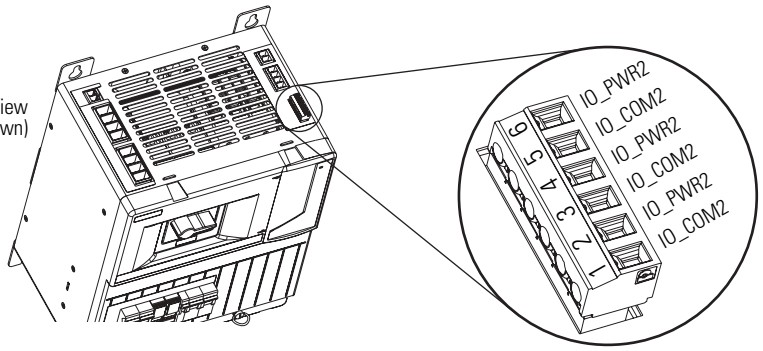
Auxiliary Power Output (P2L) Connector
2094-AL*xx*S, -BL*xx*S, -XL75S-C*x*

P2L Pin	Signal	Recommended Wire Size mm^2 (AWG)	Strip Length mm (in.)	Torque Value Nm (lb-in)
1	AUX1_L1	0.2-4.0 (24-10)	7.0 (0.28)	0.5 - 0.6 (4.4 - 5.3)
2	AUX1_L2			
3	AUX2_L1			
4	AUX2_L2			

Wiring the Brake Power Output (24V dc) Connector

Line Interface Module (24V connector)

Line Interface Module, Top View
(2094-XL75S-C*x* is shown)



Brake Power Output (24V dc) Connector
2094-AL*xx*S, -BL*xx*S, -XL75S-C*x*

P1L Pin	Signal	Recommended Wire Size mm^2 (AWG)	Strip Length mm (in.)	Torque Value Nm (lb-in)
1	IO_PWR2	0.08-1.5 (28-16)	7.0 (0.28)	0.22-0.25 (1.9-2.2)
2	IO_COM2			
3	IO_PWR2			
4	IO_COM2			
5	IO_PWR2			
6	IO_COM2			

Brake Power Output (24V dc) Connector
2094-AL09 and -BL02

PSL Pin	Signal	Recommended Wire Size mm^2 (AWG)	Strip Length mm (in.)	Torque Value Nm (lb-in)
1	MBRK PWR	2.5 (14)	10.0 (0.38)	0.5 - 0.6 (4.4 - 5.3)
2	MBRK COM			
3	MBRK PWR			
4	MBRK COM			

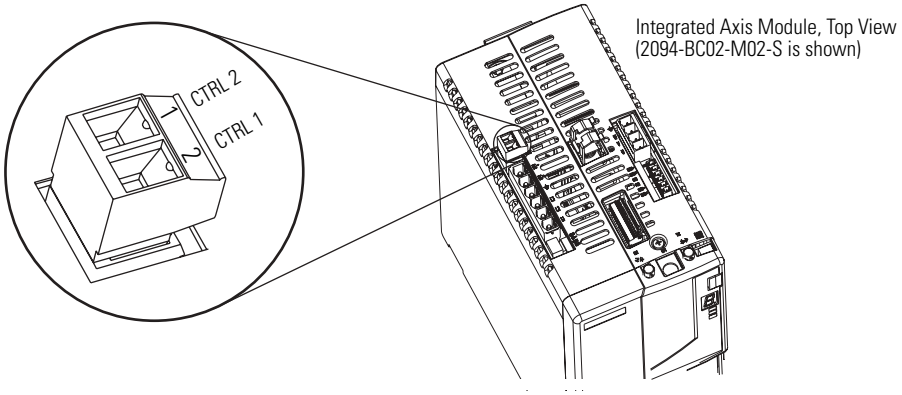
Wiring the IAM/AM Connectors

This section provides examples and wiring tables to assist you in making connections to the integrated axis module (IAM) connectors.

Wiring the Control Power (CPD) Connector

This example applies to an integrated axis module (IAM), leader IAM, or follower IAM.

Integrated Axis Module (CPD connector)



IMPORTANT LIM models (2094-AL75S and BL75S) will supply up to eight axes. LIM models (2094-XL75S-C*x*) will supply up to sixteen axes.

IMPORTANT Source the 230V IAM control power from the three-phase input power (line-to-line). Supplying 230V control power from any other source requires an isolation transformer. If used, do not ground either output leg of the isolation transformer.

Refer to Control Power Input on page 65 for more information and IAM Wiring Example (without LIM) on page 196 for the interconnect drawing.

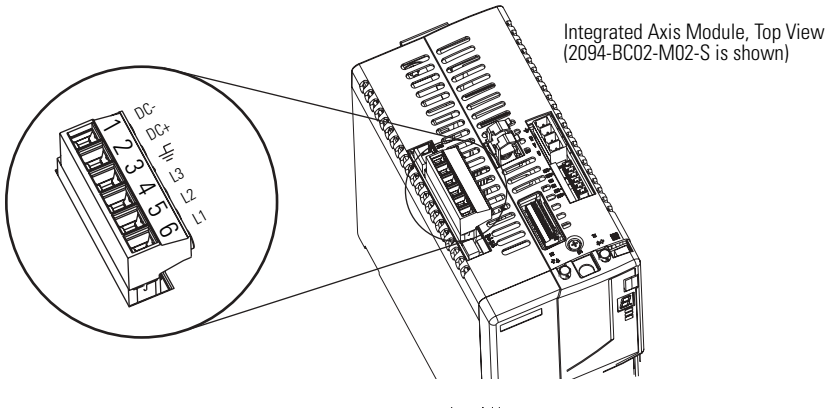
Control Power (CPD) Connector

CPL Connector (LIM) or Other Single-phase Input				CPD Connector (IAM)		Recommended Wire Size mm² (AWG)	Strip Length mm (in.)	Torque Value Nm (lb-in)
2094-AL*xx*S, -BL*xx*S, -XL75S-C*x*		2094-AL09 and -BL02						
CPL Pin	Signal	CPL Pin	Signal	CPD Pin	Signal			
1	CTRL 1	2	L1	1	CTRL 2	2.5 (14)	10 (0.38)	0.5 - 0.6 (4.4 - 5.3)
2	CTRL 2	1	L2/N	2	CTRL 1			

Wiring the Input Power (IPD) Connector

This example applies to an integrated axis module (IAM) or leader IAM (dc common bus).

Integrated Axis Module (IPD connector)



Input Power (IPD) Connections

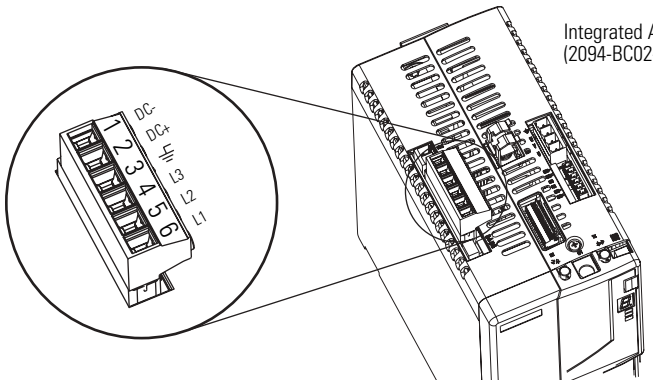
OPL Connector (LIM) or Other Three-phase Input				IPD Connector (IAM or leader IAM)	
2094-AL09		2094-BL02, -AL*xx*S, -BL*xx*S, or -XL75S-C*x*			
OPL Pin	**Signal**	**OPL Pin**	**Signal**	**IPD Pin**	**Signal**
1	L1′	4	L1′	6	L1
2	L2′	3	L2′	5	L2
3	L3′	2	L3′	4	L3
4	⏚	1	⏚	3	⏚
N/A				2	DC+
				1	DC-

Termination Specifications

Integrated Axis Module Cat. No.	Input VAC	Recommended Wire Size mm^2 (AWG)	Strip Length mm (in.)	Torque Value Nm (lb-in)
2094-AC05-M*xx*-S 2094-AC09-M*xx*-S	230V ac	2.5 (14)	10 (0.38)	0.5 - 0.6 (4.4 - 5.3)
2094-AC16-M*xx*-S		10 (8)	16 (0.63)	2.4 - 3.0 (21.6 - 26.5)
2094-AC32-M*xx*-S		25 (4)		
2094-BC01-M*xx*-S 2094-BC02-M*xx*-S	460V ac	4.0 (12)	10 (0.38)	1.2 - 1.5 (10.6 - 13.2)
2094-BC04-M*xx*-S		10 (8)	16 (0.63)	2.4 - 3.0 (21.6 - 26.5)
2094-BC07-M*xx*-S		25 (4)		

This example applies to a follower IAM (dc common bus).

Integrated Axis Module (IPD connector)



Input Power (IPD) Connections

IPD Connector (IAM or follower IAM)	
IPD Pin	**Signal**
6	N.C.
5	N.C.
4	N.C.
3	⏚
2	DC+
1	DC-

IMPORTANT Do not connect three-phase input power to the follower IAM.

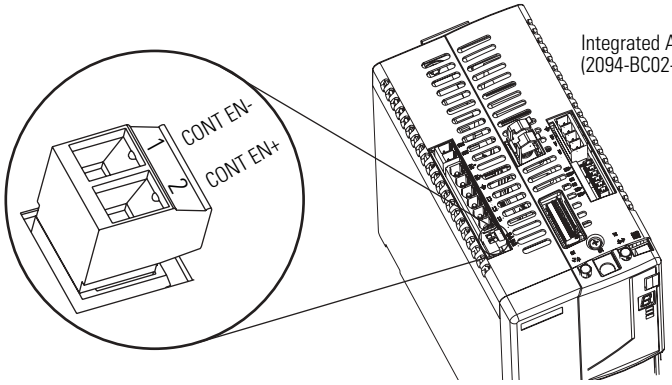
Termination Specifications

Integrated Axis Module Cat. No.	Input VAC	Recommended Wire Size mm^2 (AWG)	Strip Length mm (in.)	Torque Value Nm (lb-in)
2094-AC05-M*xx*-S 2094-AC09-M*xx*-S	230V ac	2.5 (14)	10 (0.38)	0.5 - 0.6 (4.4 - 5.3)
2094-AC16-M*xx*-S		10 (8)	16 (0.63)	2.4 - 3.0 (21.6 - 26.5)
2094-AC32-M*xx*-S		25 (4)		
2094-BC01-M*xx*-S 2094-BC02-M*xx*-S	460V ac	4.0 (12)	10 (0.38)	1.2 - 1.5 (10.6 - 13.2)
2094-BC04-M*xx*-S		10 (8)	16 (0.63)	2.4 - 3.0 (21.6 - 26.5)
2094-BC07-M*xx*-S		25 (4)		

Wiring the Contactor Enable (CED) Connector

This example applies to any integrated axis module (IAM), leader IAM, or follower IAM.

Integrated Axis Module (CPD connector)



Integrated Axis Module, Top View
(2094-BC02-M02-S is shown)

ATTENTION

Wiring the contactor enable relay is required. To avoid personal injury or damage to the drive, wire the contactor enable relay into your safety control string.

Refer to Contactor Enable Relay on page 63.

In common bus configurations, the contactor enable (CED) connections for leader and follower drives must be wired in series to the safety control string.

For interconnect diagrams, refer to Wiring Examples beginning on page 192.

Contactor Enable (CED) Connector

LIM I/O (IOL) Connector or Other Control String		CED Pin	Signal	Recommended Wire Size mm^2 (AWG)	Strip Length mm (in.)	Torque Value Nm (lb-in)
2094-AL*xx*S, -BL*xx*S, -XL75S-C*x*	2094-AL09 and -BL02					
IO_COM1	IO_COM	1	CONT EN-	2.5 (14) [1]	10 (0.38)	0.5 - 0.6 (4.4 - 5.3)
COIL_E2	COIL_A2	2	CONT EN+			

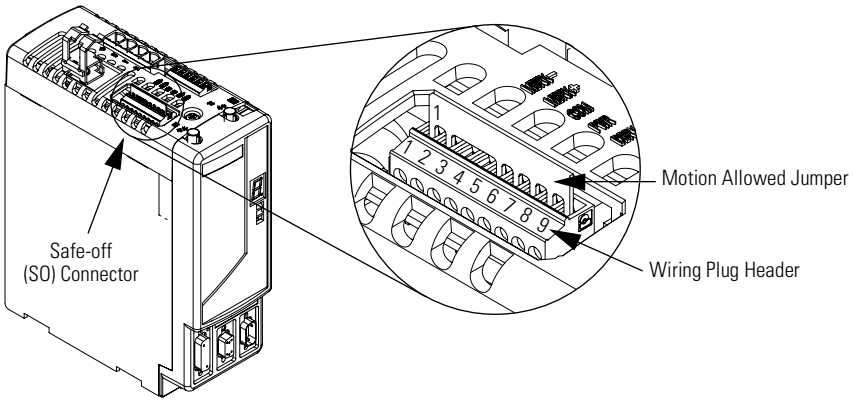
[1] The actual gauge of the contactor enable wiring depends on the system configuration. Consult your machine builder, the NEC, and applicable local codes.

Wiring the Safe-off (SO) Connector

This example applies to any integrated axis module (IAM) or axis module (AM) equipped with the safe-off (SO) connector.

Integrated Axis Module (CED connector)

Kinetix 6000 IAM/AM
(Kinetix 6000 AM is shown)



Each IAM and AM ships with the (9-pin) wiring plug header and motion allowed jumper installed in the safe-off connector. With the motion allowed jumper installed, the safe-off feature is not used.

Pinouts for the safe-off (SO) connector are shown on page 52.

IMPORTANT Pins SO-8 and -9 (24V+) are only used by the motion allowed jumper. When wiring to the wiring plug header, the 24V supply must come from an external source.

Safe-off (SO) Connector

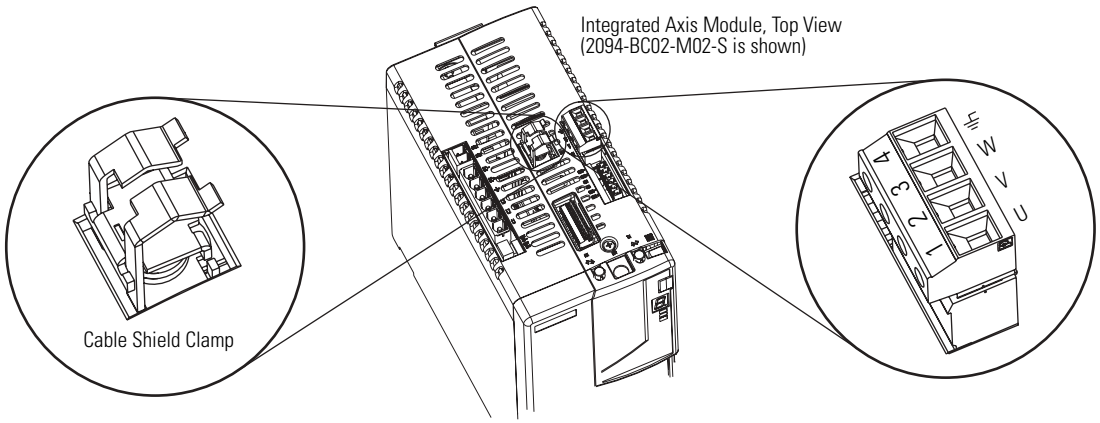
CED Pin	Signal	Recommended Wire Size mm^2 (AWG)	Strip Length mm (in.)	Torque Value Nm (lb-in)
1	FDBK2+	0.75 (18) (stranded wire with ferrule) 1.5 (16) (solid wire)	7.0 (0.275)	0.235 (2.0)
2	FDBK2-			
3	FDBK1+			
4	FDBK1-			
5	SAFETY ENABLE2+			
6	SAFETY ENABLE-			
7	SAFETY ENABLE1+			
8	24V +			
9	24V_COM			

To wire the safe-off connector in single axis or multi-axis configurations, refer to the Kinetix Safe-off Feature Safety Reference Manual, publication GMC-RM002.

Wiring the Motor Power (MP) Connector

This example applies to axis modules (AM) and the inverter section of integrated axis modules (IAM).

Integrated Axis Module/Axis Module (MP connector)



Cable Shield Terminations

Factory supplied motor power cables for MP-Series, TL-Series, 1326AB, F-, and Y-Series motors are shielded, and the braided cable shield must terminate at the drive during installation. A small portion of the cable jacket must be removed to expose the shield braid. The exposed area must be clamped (using the clamp provided) on top of the IAM or AM and the power wires terminated in the motor power (MP) connector plug.

SHOCK HAZARD

To avoid hazard of electrical shock, ensure shielded power cables are grounded at a minimum of one point for safety.

IMPORTANT

For TL- and Y-Series motors, also connect the 152 mm (6.0 in.) termination wire to the closest earth ground.

Refer to Pigtail Terminations on page 100 for more information.

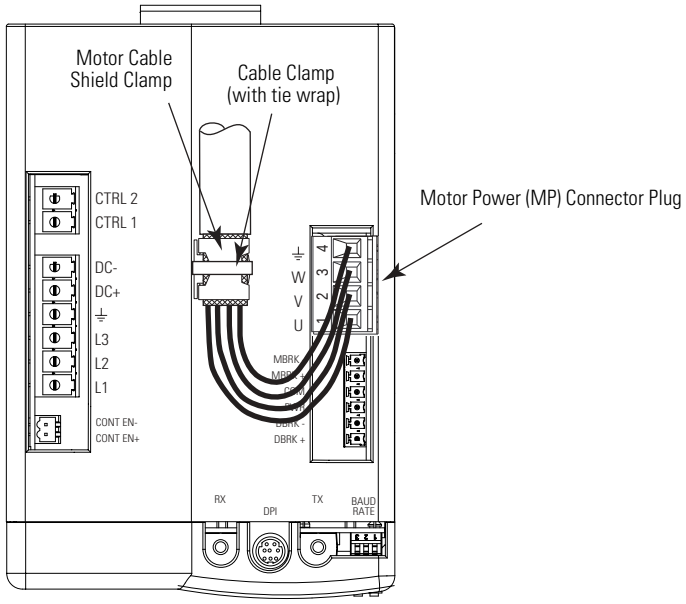
Motor Power Cables with Three-phase Wires Only

Motor	Motor Catalog Number	Motor Power Cable Catalog Number
MP-Series Low Inertia	MPL-A/B3*xxx*, -A/B4*xxx*, -A/B45*xxx*, -A/B5*xxx*, -B6*xxx*, -B8*xxx*, -B9*xxx*, S/M	2090-XXNPMP-*xx*S*xx*
MP-Series Integrated Gear	MPG-A/B*xxxx*S/M	
1326AB (M2L/S2L)	1326AB-B*xxxx*-M2L/S2L	
TL-Series	TL-A*xxxx*-H	2090-XXNPT-16S*xx*
F-Series	F-*xxxx*	2090-XXNPHF-*xx*S*xx*

These cables only contain the three-phase wires and the motors have a separate connector for brake connections. Thermal switch wires are included in the feedback cable.

IMPORTANT No drive-end preparation is required for these cables.

Motor Power Terminations (three-phase wires only)



The cable shield clamp shown above is mounted to an IAM. Cables attach to the clamp on each AM in the same way.

IMPORTANT Securing the cable shield in the clamp with a tie wrap is recommended to improve stress relief.

Motor Power Cables with Three-phase and Brake Wires

Motor	Motor Catalog Number	Motor Power Cable Catalog Number
MP-Series Low Inertia	MPL-A/B15*xxx* and MPL-A/B2*xxx* V/E	2090-XXNPMF-*xx*S*xx*
MP-Series Food Grade	MPF-A/B*xxxx*S/M	
MP-Series Stainless Steel	MPS-A/B*xxxx*S/M	
Y-Series	Y-*xxxx*	2090-XXNPY-16S*xx*

These MP-Series brake wires have a shield braid (shown below as gray) that folds back under the cable clamp before the conductors are attached to the motor brake (BC) connector. Y-Series brake wires are not shielded and do not require routing under the cable clamp.

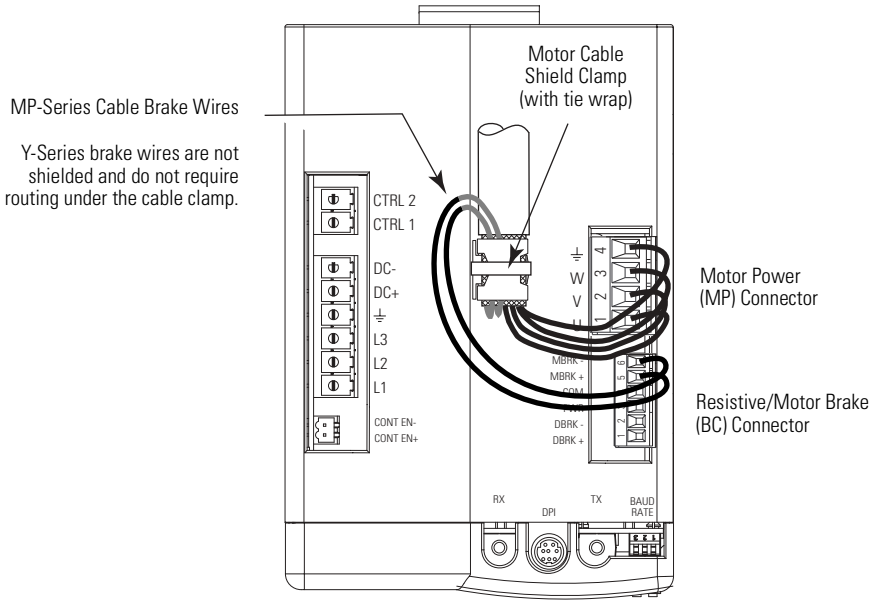
The thermal switch wires for the MP-Series motors are included in the feedback cable.

Refer to Axis Module/Motor Wiring Examples beginning on page 204 for interconnect diagrams.

IMPORTANT No drive-end preparation is required for these cables.

Refer to page 99 for drive-end cable pinouts.

Motor Power Terminations (three-phase and brake wires)



The cable shield clamp shown above is mounted to an IAM. Cables attach to the clamp on each AM in the same way.

IMPORTANT Securing the cable shield in the clamp with a tie wrap is recommended to improve stress relief.

Motor Power Cables with Three-phase, Brake, and Thermal Switch Wires

Motor	Motor Catalog Number	Motor Power Cable Catalog Number
1326AB (resolver)	1326AB-B*xxxx*-21	1326-CP*x*1-*xxx*

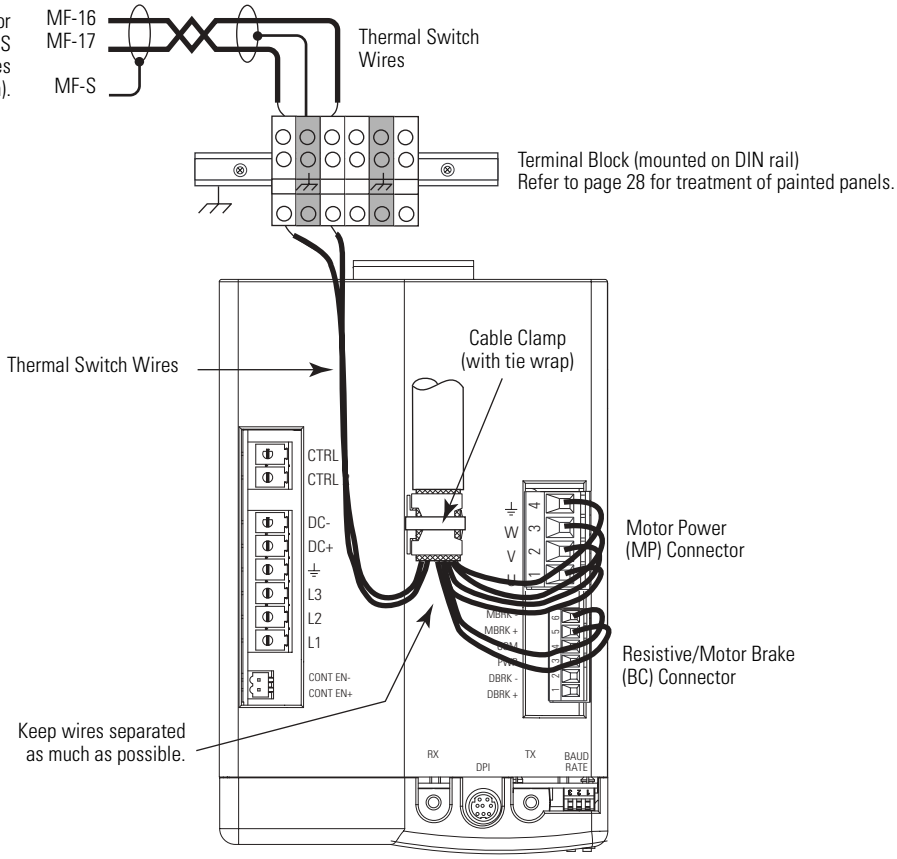
The 1326AB (resolver) power cable contains the three-phase wires, brake wires, and thermal switch wires. To improve the EMC performance of your system, route the wires as shown.

IMPORTANT Drive-end preparation is required for these cables.

Refer to page 99 for drive-end pinouts and cable preparation.

Motor Power Terminations (three-phase, brake, and thermal switch wires)

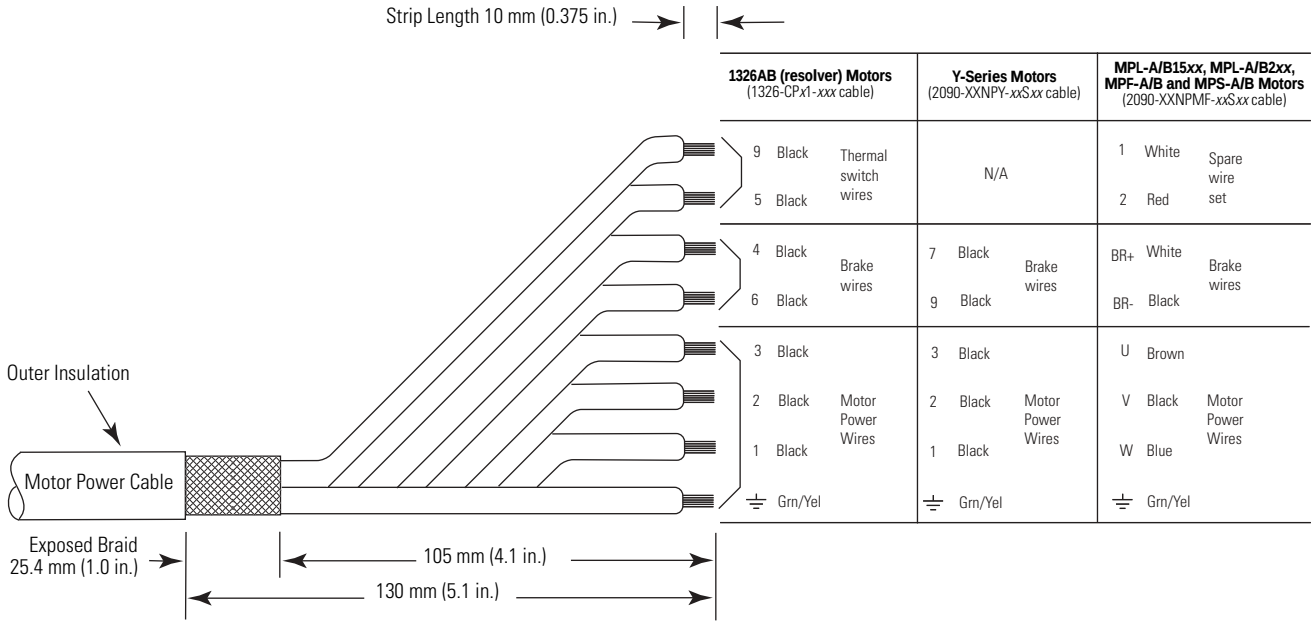
Low-profile motor feedback connector (2090-K6CK-D15MF) pins 16, 17, and S provide filtering for 1326-CP*x*1-*xxx* cables (refer to page 111 for an illustration).



The cable shield clamp shown above is mounted to an IAM. Cables attach to the clamp on each AM in the same way.

IMPORTANT Securing the cable shield in the clamp with a tie wrap is recommended to improve stress relief.

Shield Clamp Cable Preparation (1326-CP*x*1-*xxx*)
Cable Pinouts (2090-XXNPY-16S*xx*, and 2090-XXNPMF-*xx*S*xx*)



Refer to Axis Module/Motor Wiring Examples beginning on page 204 for interconnect diagrams.

Motor Power (MP) Connector

Servo Motor		MP Connector (IAM/AM)	
1326AB (resolver) and Y-Series	**1326AB (M2L/S2L), F-, TL-, and MP-Series**	**MP Pin**	**Signal**
1 / Black	U / Brown	1	U
2 / Black	V / Black	2	V
3 / Black	W / Blue	3	W
Green/Yellow	⏚ Green/Yellow	4	⏚

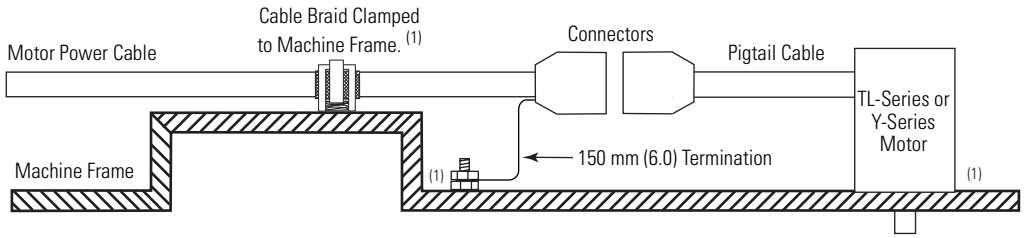
Termination Specifications

IAM/AM Cat. No.	Recommended Wire Size mm² (AWG)	Strip Length mm (in.)	Torque Value Nm (lb-in)
2094-AC05-M*xx*-S 2094-AC09-M*xx*-S 2094-BC01-M*xx*-S 2094-BC02-M*xx*-S 2094-AMP5-S, -AM01-S, -AM02-S, -BMP5-S, -BM01-S, and -BM02-S	Motor power cable depends on motor/drive combination.	10 (0.38)	0.5 - 0.6 (4.4 - 5.3)
2094-AC16-M*xx*-S 2094-AC32-M*xx*-S 2094-AM03-S, -AM05-S	6 (10) max	10 (0.38)	1.2 - 1.5 (10.6 - 13.2)
2094-BC04-M*xx*-S 2094-BC07-M*xx*-S 2094-BM03-S, -BM05-S	25 (4) max	16 (0.63)	2.4 - 3.0 (21.6 - 26.5)

Pigtail Terminations

TL- and Y-Series motors have a short pigtail cable which connects to the motor, but is not shielded. The preferred method for grounding the TL- and Y-Series motor power cable on the motor side is to expose a section of the cable shield and clamp it directly to the machine frame. The motor power cable also has a 150 mm (6.0 in.) shield termination wire with a ring lug that connects to the closest earth ground. Use this method in addition to the cable clamp. The termination wire may be extended to the full length of the motor pigtail if necessary, but it is best to connect the supplied wire directly to ground without lengthening.

Pigtail Terminations

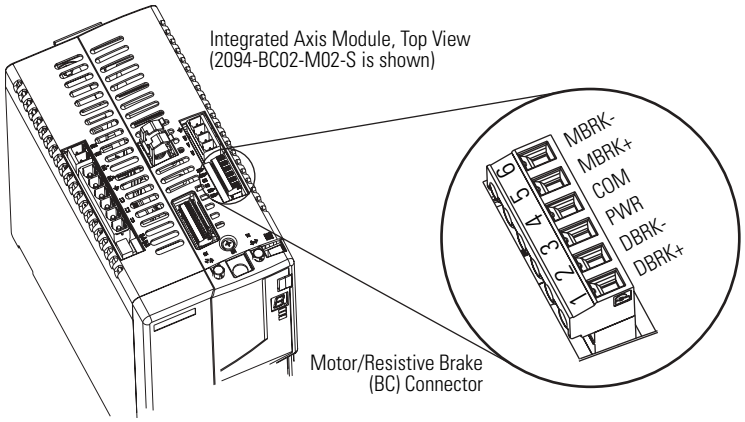


(1) Remove paint from machine frame to ensure proper HF-bond between machine frame and motor case, shield clamp, and ground stud.

Wiring the Motor/Resistive Brake (BC) Connector

This example applies to axis modules (AM) and the inverter section of integrated axis modules (IAM).

Integrated Axis Module/Axis Module (BC connector)



Wiring 24V dc Brake Input Power Connections

IMPORTANT If your system includes a line interface module (LIM), you can source the 24V dc from the LIM (P1L or PSL connector).

Motor/Resistive Brake (BC) Connector

2094-AL*xx*S, -BL*xx*S, -XL75S-C*x*		2094-AL09 and -BL02		BC Connector (IAM/AM)	
P1L Pin	**Signal**	**PSL Pin**	**Signal**	**BC Pin**	**Signal**
1	IO_PWR2	1	MBRK PWR	3	PWR
2	IO_COM2	2	MBRK COM	4	COM

Wiring the Resistive Brake Module (RBM) Connections

Motor/Resistive Brake (BC) Connector

RBM I/O Connections		BC Connector (IAM/AM)	
TB3 Pin	**Signal**	**MP Pin**	**Signal** (1)
6	COIL_A1	1	DBRK+
7	COIL_A2	2	DBRK-

(1) Firmware version 1.071 or later, is required to use the DBRK outputs on the Kinetix 6000 IAM/AM.

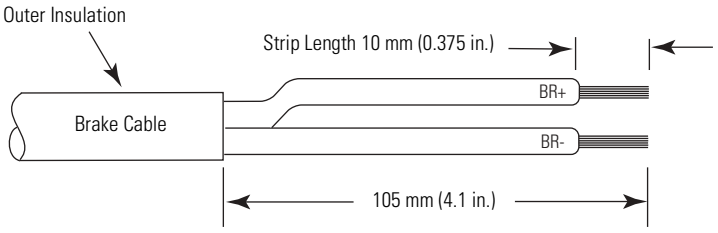
Wiring the Motor Brake Connections

The procedure for wiring your motor brake varies slightly, depending on the motor series you are using. Refer to the table below to determine where the brake wires for your servo motor are located and for the appropriate brake cable or connector kit catalog number.

Motor Series	Brake Wires	Cable Catalog Number
MPL-A/B3*xxx*, MPL-A/B4*xxx*, MPL-A/B45*xxx*, MPL-A/B5*xxx*, MPL-B6*xxx*, MPL-B8*xxx*, MPL-B9*xxx*, and MPG-A/B	The motor has a brake connector. Brake wires are in the brake cable.	2090-UXNBMP-18S*xx* brake cable
1326AB (M2L/S2L)		
TL-A*xxxx*-H		2090-DANBT-18S*xx* brake cable
F-Series		Straight brake connector kit 9101-0330
MPL-A/B15*xxx*, MPL-A/B2*xxx*, MPF-A/B and MPS-A/B	The motor does not have a brake connector. Brake wires are included in the power cable.	2090-XXNPMF-*xx*S*xx* power cable
1326AB (resolver)		1326-CP*x*1-*xxx* power cable
Y-Series		2090-XXNPY-16S*xx* power cable

IMPORTANT Use surge suppression when controlling a brake coil. Refer to Controlling a Brake Example on page 210.

Brake Cable Preparation



Motor/Resistive Brake (BC) Connector

Motor Brake Wires					BC Connector (IAM/AM)	
2090-UXNBMP-18S*xx* Brake Cable	**2090-DANBT-18S*xxx* Brake Cable**	**2090-XXNPMF-*xx*S*xx* Power Cable**	**1326-CP*x*1-*xxx* Power Cable**	**2090-XXNPY-16S*xx* Power Cable**	**BC Pin**	**Signal**
A / BR+	1 / BR+	F/+ / BR+	6 / B1	7 / BR+	5	MBRK+
C / BR-	2 / BR-	G/- / BR-	4 / B2	9 / BR-	6	MBRK-

Termination Specifications

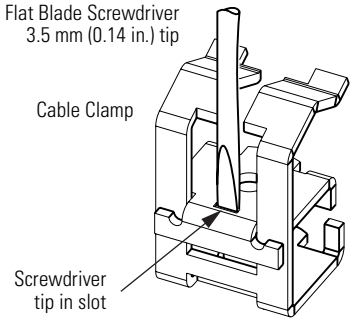
BC Connector (IAM/AM)		Recommended Wire Size mm^2 (AWG)	Strip Length mm (in.)	Torque Value Nm (lb-in)
BC Pin	**Signal**			
BC-6 BC-5 BC-4 BC-3 BC-2 BC-1	MBRK- MBRK+ COM PWR DBRK- DBRK+	0.75 (18)	10 (0.38)	0.22 - 0.25 (1.9 - 2.2)

Applying the Motor Cable Shield Clamp

This procedure assumes you have completed wiring your motor power (MP) connector and are ready to apply the motor cable shield clamp.

Follow these steps to apply the motor cable shield clamp.

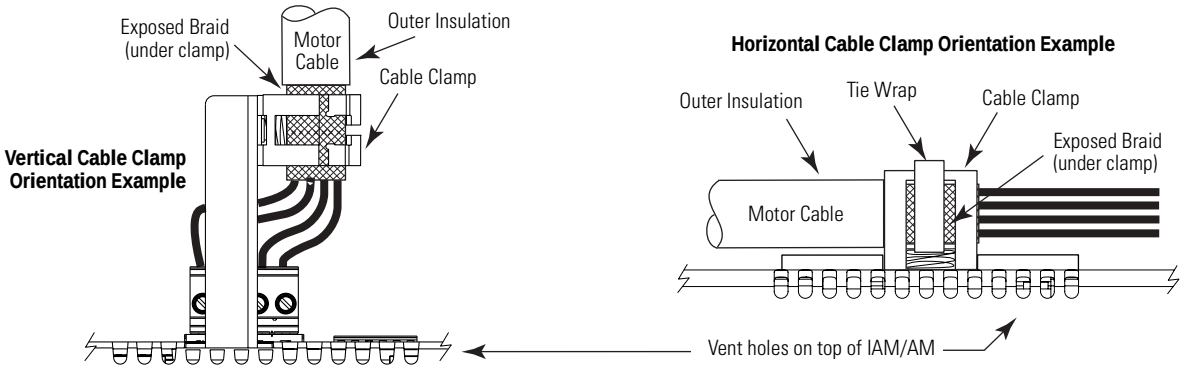
1. Use a small flat blade screwdriver to depress the spring loaded clamping plate.



2. Position the exposed portion of the cable braid directly in line with the clamp.

3. Release the spring, making sure the cable and cable braid are held secure by the clamp.

4. Attach tie wrap around cable and clamp for additional strain relief.



5. Repeat Steps 1...4 for each AM and IAM.

Understanding Feedback and I/O Cable Connections

Factory made cables with premolded connectors are designed to minimize EMI and are recommended over hand-built cables to improve system performance. However, other options are available for building your own feedback and I/O cables.

Options for Connecting Motor Feedback and I/O

Connection Option	Connector Kit Catalog Number	Cable	Using this Type of Cable
Premolded connectors	N/A	Motor feedback	Refer to the table below for the premolded motor feedback cable available for your motor.
Low-profile connector	2090-K6CK-D15M	Motor feedback	Refer to the table below for the flying-lead cable available for your motor.
	2090-K6CK-D15MF		1326-CCU*x-xxx*.
	2090-K6CK-D15F	Auxiliary feedback	User-supplied flying-lead cable.
	2090-K6CK-D26M	I/O interface	User-supplied flying-lead cable.
Panel-mounted breakout board kits	2090-UXBK-D15*xx* (1)	Motor feedback	Refer to the table below for the flying-lead cable available for your motor.

(1) Not compatible with 1326-CCU*x-xxx* cable.

Motor Feedback Cables for Specific Motor/Feedback Combinations

Motor Series	Feedback Type	Feedback Cable		Pinout
		Premolded	Flying-Lead	
MPL-A*xxxx*S/M MPL-B*xxxx*S/M	High-resolution encoder	2090-UXNFBMP-S*xx*	2090-XXNFMP-S*xx*	page 105
MPL-A3*xxx*-H MPL-A4*xxx*-H MPL-A45*xxx*-H MPL-A5*xxx*-H	Incremental encoder			
MPG-A*xxxx*-S/M MPG-B*xxxx*-S/M	High-resolution encoder			
MPL-B*xxxx*-R	Motor resolver	N/A	2090-CDNFDMP-S*xx*	page 105
MPL-A15*xxx*-H MPL-A2*xxx*-H MPL-B15*xxx*-H MPL-B2*xxx*-H	Incremental encoder	N/A	2090-XXNFMF-S*xx*	page 106
MPL-A*xxxx*-V/E MPL-B*xxxx*-V/E	High-resolution encoder			
MPF-A*xxxx*-S/M MPF-B*xxxx*-S/M				
MPS-A*xxxx*-S/M MPS-B*xxxx*-S/M				
TL-A*xxxx*-H	Incremental encoder	2090-XXNFT-S*xx*	N/A	page 106
1326AB-B*xxxx*-M2L/S2L	High-resolution encoder	2090-UXNFBMP-S*xx*	2090-XXNFMP-S*xx*	page 105
1326AB-B*xxxx*-21	Motor resolver	N/A	1326-CCU*x-xxx*	page 107
F-Series	Incremental encoder	2090-UXNFBHF-S*xx*	2090-XXNFHF-S*xx*	page 107
Y-Series		2090-UXNFBY-S*xx*	2090-XXNFY-S*xx*	page 107

Flying-lead Feedback Cable Pin-outs

2090-XXNFMP-S*xx* Feedback Cable

Motor Connector Pin	Motors with High Resolution Feedback		Motors with Incremental Encoder Feedback	Drive MF Connector Pin
	MPL-B*xxx*-M/-S MPL-A5*xxx*-M/-S 1326AB-B*xxx*-M2L/-S2L	MPL-A3*xxx*-M/-S MPL-A4*xxx*-M/-S MPL-A45*xxx*-M/-S MPG-A/B*xxx*-M/-S	MPL-A3*xxx*-H MPL-A4*xxx*-H MPL-A45*xxx*-H MPL-A5*xxx*-H	
A	Sine+	Sine+	AM+	1
B	Sine-	Sine-	AM-	2
C	Cos+	Cos+	BM+	3
D	Cos-	Cos-	BM-	4
E	Data+	Data+	IM+	5
F	Data-	Data-	IM-	10
K	Reserved	EPWR_5V	EPWR_5V	14
L	Reserved	ECOM	ECOM	6
N	EPWR_9V	Reserved	Reserved	7
P	ECOM	Reserved	Reserved	6
R	TS+	TS+	TS+	11
S	TS-	TS-	TS-	–
T	Reserved	Reserved	S1	12
U	Reserved	Reserved	S2	13
V	Reserved	Reserved	S3	8

2090-CDNFDMP-S*xx* Feedback Cable

Motor Connector Pin	Resolver Feedback MPL-B*xxxx*-R Motors	Drive MF Connector Pin
A	S2	1
B	S4	2
C	S1	3
D	S3	4
G	R1	5
H	R2	10
R	TS+	11
S	TS-	6

2090-XXNFMF-S*xx* Feedback Cable

Motor Connector Pin	Motors with High Resolution Feedback		Motors with Incremental Encoder Feedback	Drive MF Connector Pin
	MPL-B15*xxx*-V/-E MPL-B2*xxx*-V/-E MPF/MPS-B*xxx*-M/-S MPF-A5*xx*-M/-S	**MPL-A15*xxx*-V/-E MPL-A2*xxx*-V/-E MPF/MPS-A3*xx*-M/-S MPF/MPS-A4*xx*-M/-S MPF/MPS-A45*xx*-M/-S MPS-A5*xx*-M/-S**	**MPL-A15*xxx*-H MPL-A2*xxx*-H MPL-B15*xxx*-H MPL-B2*xxx*-H**	
1	Sine+	Sine+	AM+	1
2	Sine-	Sine-	AM-	2
3	Cos+	Cos+	BM+	3
4	Cos-	Cos-	BM-	4
5	Data+	Data+	IM+	5
6	Data-	Data-	IM-	10
9	Reserved	EPWR_5V	EPWR_5V	14
10	Reserved	ECOM	ECOM	6
11	EPWR_9V	Reserved	Reserved	7
12	ECOM	Reserved	Reserved	6
13	TS+	TS+	TS+	11
14	TS-	TS-	TS-	–
15	Reserved	Reserved	S1	12
16	Reserved	Reserved	S2	13
17	Reserved	Reserved	S3	8

2090-XXNFHF-S*xx* Feedback Cable

Motor Connector Pin	Incremental Encoder Feedback	Drive MF Connector Pin
	F-Series Motors	
A	AM+	1
B	AM-	2
C	BM+	3
D	BM-	4
E	IM+	5
F	IM-	10
G	Reserved	–
H	Reserved	–
J	EPWR_5VM	14
K	EPWR_5VM	14
L	ECOMM	6
M	ECOMM	6
N	S2	13
P	S3	8
R	TS+	11
S	TS-	6
T	S1	12

2090-XXNFY-S*xx* Feedback Cable

Motor Connector Pin	Incremental Encoder Feedback	Drive MF Connector Pin
	Y-Series Motors	
9	AM+	1
10	AM-	2
11	BM+	3
12	BM-	4
13	IM+	5
14	IM-	10
15	S1	12
17	S2	13
19	S3	8
22	EPWR_5VM	14
23	ECOMM	6
24	Drain	Connector Housing
Reserved	Reserved	7
Reserved	Reserved	9
Reserved	Reserved	11
Reserved	Reserved	15

1326-CCU-*xxx* Feedback Cable

Motor Connector Pin	Resolver Feedback 1326AB-B*xxxx*-21	Drive MF Connector Pin (1)
A	R1	5
B	R2	10
C	–	–
D	S1	3
E	S3	4
F	–	–
G	S2	1
H	S4	2

1326-CP*x*1-*xxx* Power Cable

Motor Connector Pin	Thermal Switch Connections 1326AB-B*xxxx*-21	Drive MF Connector Pin (2)
5	TS+	16
9	TS-	17
–	Shield	S

(1) For termination of individual drain wires, use Low Profile connector kit (2090-K6CK-D15MF) and reference figure on page 111.

(2) Thermal switch wires (5 and 9) are in the motor power cable (1326-CP*x*1-*xxx*). Use Low Profile connector kit (2090-K6CK-D15MF) and reference figure on page 111.

Wiring Feedback and I/O Connectors

These procedures assume you have mounted your Kinetix 6000 system, completed all power wiring, and are ready to connect your feedback and I/O cables.

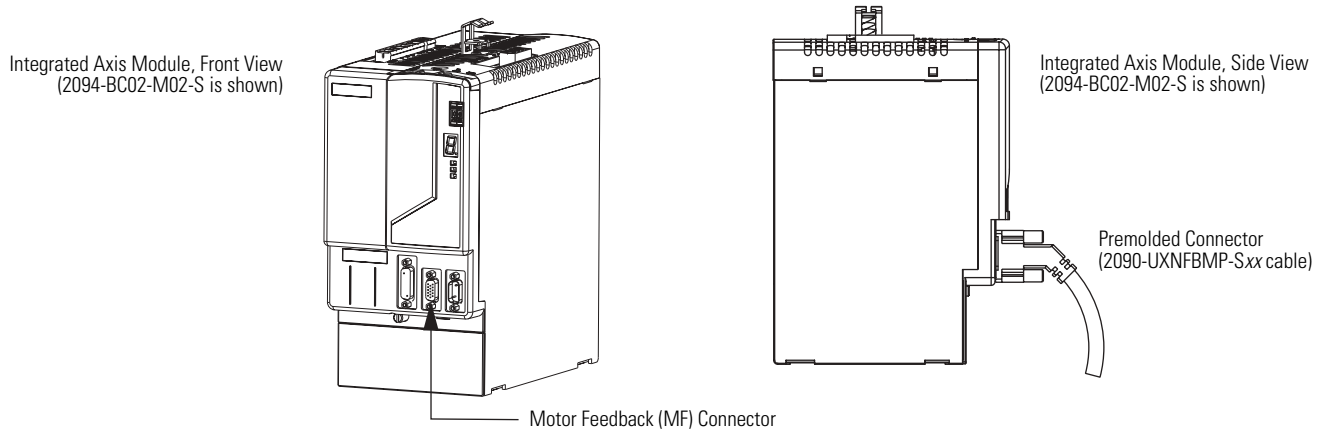
For This Connection	Go to
Premolded cable	Connecting Premolded Motor Feedback Cables on page 108.
Panel-mounted breakout board	Wiring Panel-mounted Breakout Board Kits on page 109.
Low-profile connector	Wiring Low-profile Connector Kits on page 110.

Connecting Premolded Motor Feedback Cables

Motor feedback cables with premolded connectors plug directly into 15-pin motor feedback (MF) connectors on either the IAM or AM (no wiring is necessary).

IMPORTANT When using Bulletin 2090 cables with premolded connectors, tighten the mounting screws (finger tight) to improve system performance.

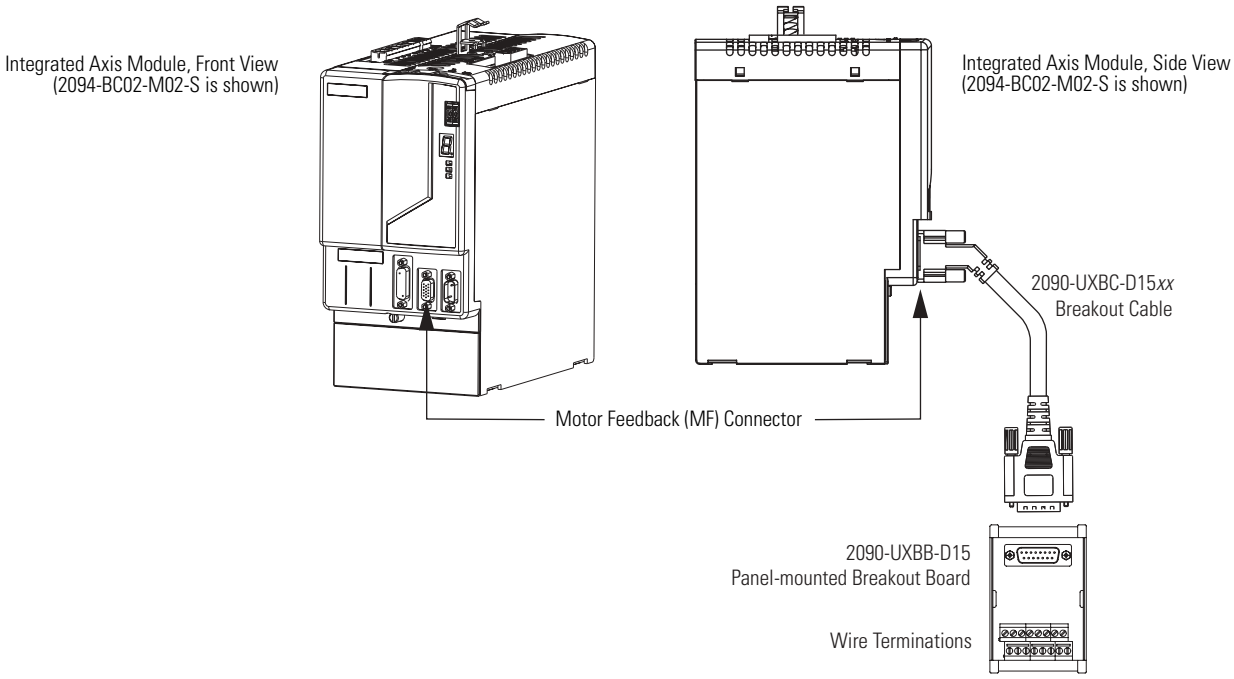
Integrated Axis Module/Axis Module (MF connector)



Wiring Panel-mounted Breakout Board Kits

The panel-mounted breakout board kit (catalog number 2090-UXBK-D15*xx*) includes a (DIN rail) breakout board and cable. The cable connects between the breakout board and the motor feedback (MF) connector. Wires from your flying-lead motor feedback cable connect to the terminals.

Integrated Axis Module/Axis Module (MF connector)

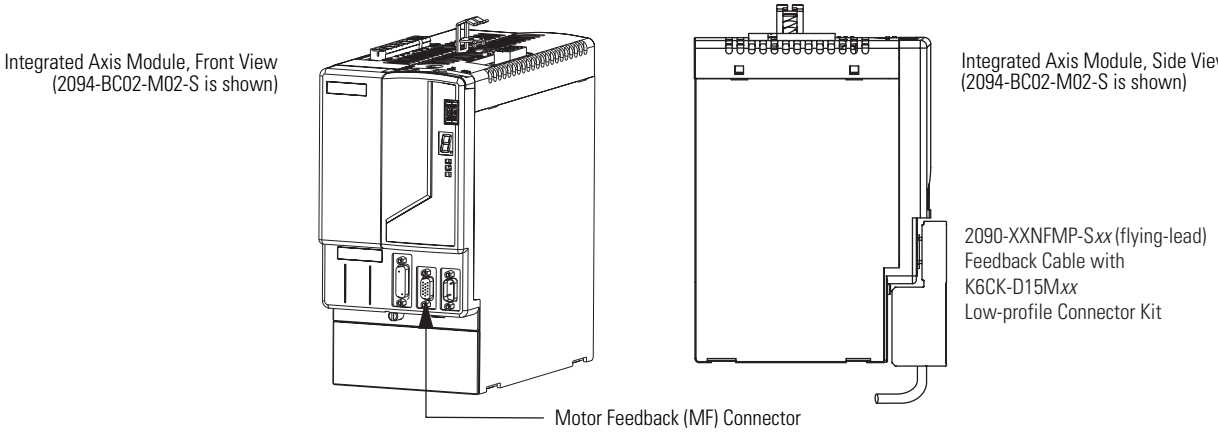


IMPORTANT The panel-mounted breakout board kit (2090-UXBK-D15*xx*) is not compatible with 1326-CCU*x-xxx* cable.

Wiring Low-profile Connector Kits

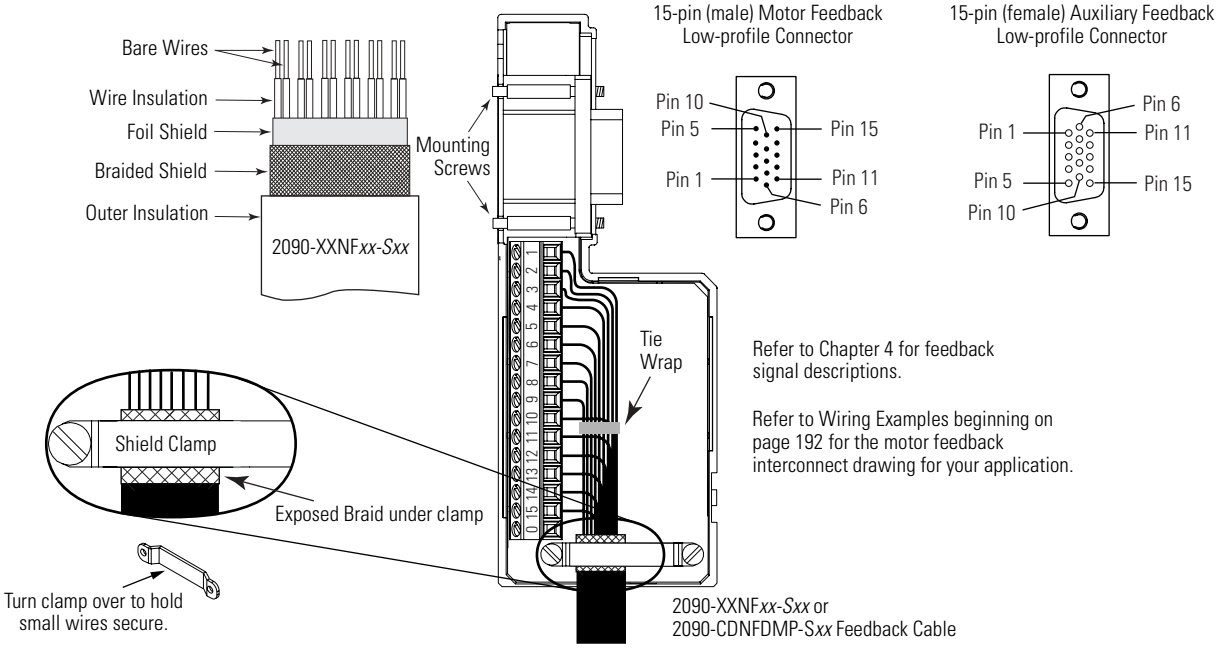
Low-profile connector kits (2090-K6CK-D*xxx*) are suitable for motor feedback (MF), auxiliary feedback (AF), and I/O connections (IOD) on any IAM or AM. They also apply to I/O connections (IOL) on the 2094-AL09 and 2094-BL02 line interface module (LIM).

Integrated Axis Module/Axis Module (MF connector)



IMPORTANT Tightening the mounting screws is essential to ensure shield integrity of the low-profile connector covers with the drive feedback connector D-shells. Use 0.4 Nm (3.5 lb-in) torque.

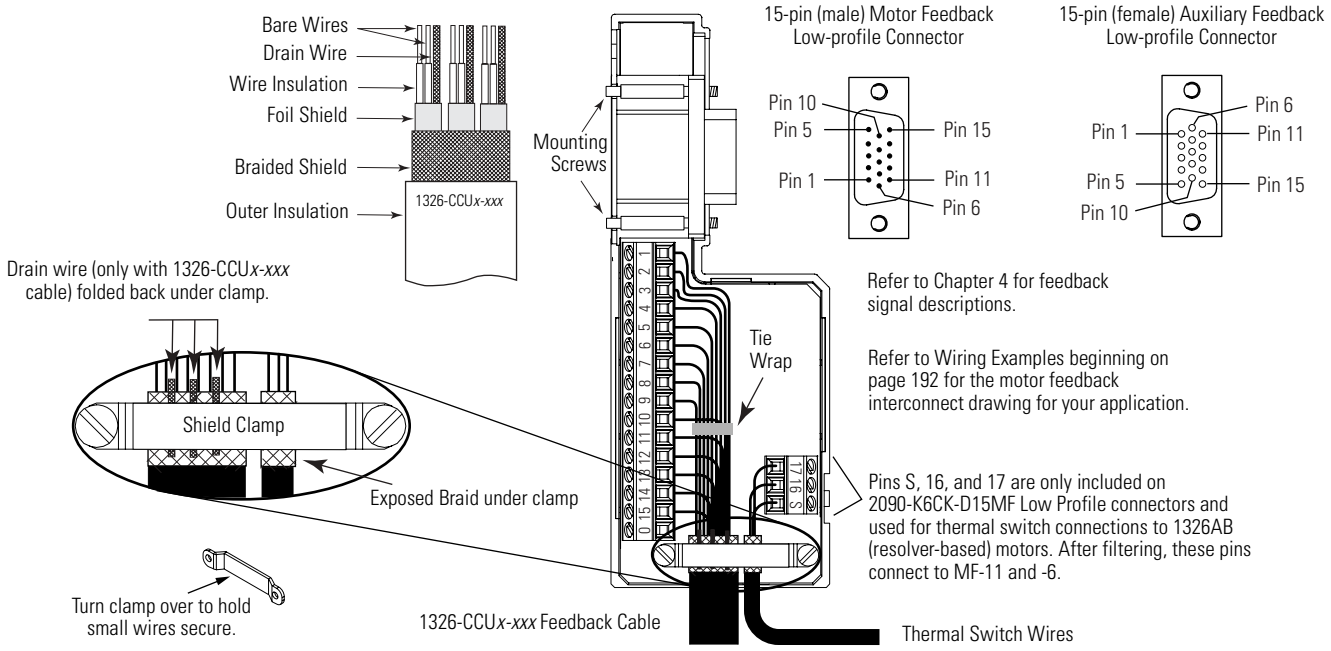
Wiring (15-Pin) Flying-lead Feedback Cable Connections 2090-XXNF*xx*-S*xx* or 2090-CDNFDMP-S*xx* Feedback Cable



Refer to Chapter 4 for feedback signal descriptions.

Refer to Wiring Examples beginning on page 192 for the motor feedback interconnect drawing for your application.

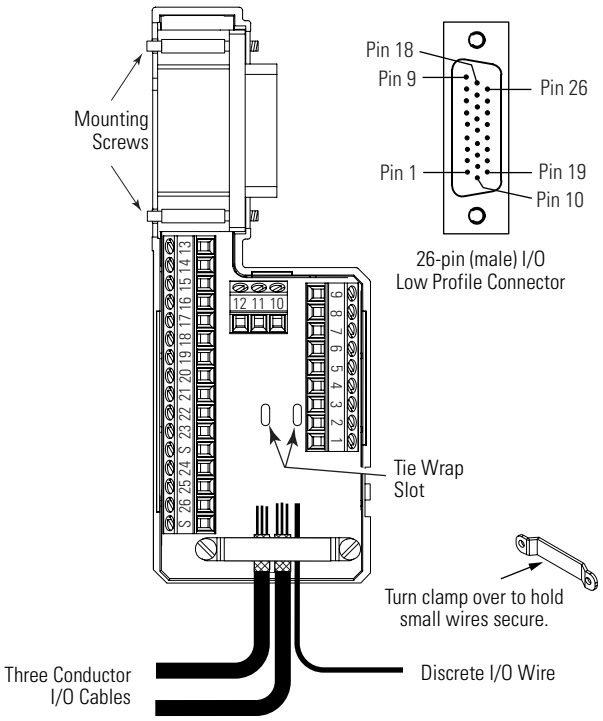
Wiring (15-Pin) Flying-lead Feedback Cable Connections
1326-CCU*x-xxx* Motor Feedback Cable



IMPORTANT The purpose of the cable shield clamp is to provide a proper ground and improve system performance, not stress relief.

Clamping the exposed braid under the shield clamp is critical. Turn clamp over, if necessary, to ensure a proper ground.

Wiring (26-Pin) I/O Cable Connections



IMPORTANT Clamping the exposed braid under the shield clamp is critical. Turn clamp over, if necessary, to ensure a proper ground.

Understanding External Shunt Module Connections

Follow these guidelines when wiring your external active or passive shunt resistor kit.

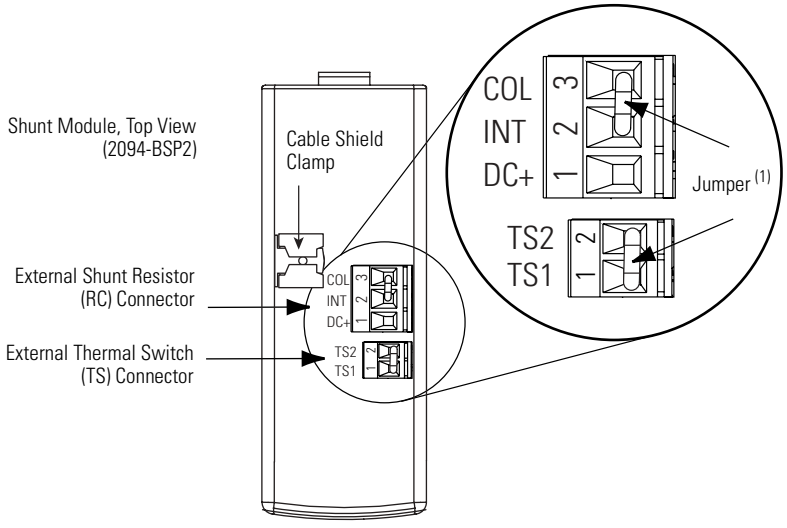
IMPORTANT When tightening screws to secure the wires, refer to the tables beginning on page 80 for torque values.

IMPORTANT To ensure system performance, run wires and cables in the wireways as established in Chapter 2.

Shunt Module Wiring

This Shunt Module	Cat. No.	With This Module	Do This
Power rail mounted shunt module.	2094-BSP2	N/A	• Verify the internal shunt jumper is in place between RC-2 and RC-3, as shown in the figure below. • Verify the thermal switch jumper is in place between TS-1 and TS-2, as shown in the figure below.
External passive shunt connected to the power rail shunt module.	1394-SR*xxxx*	SM 2094-BSP2	• Remove the internal shunt jumper between RC-2 and RC-3. • Remove the thermal switch jumper between TS-1 and TS-2 (if your shunt module includes a thermal switch). • Refer to External Shunt Resistor on page 40 and Mounting the External Shunt Module on page 48. • Refer to Locating Shunt Module Connectors and Indicators on page 68. • Refer to Shunt Module Wiring Examples on page 201.
External active shunt connected to the dc bus.	1336-MOD-K*xxxx*	IAM 2094-*x*C*xx*-M*xx*	• Refer to External Shunt Resistor on page 40. • Refer to Shunt Module Wiring Examples on page 201. • Refer to the installation instructions provided with your Bulletin 1336 shunt module, publication 1336-5.64.

Shunt Module Jumper Settings



(1) These are the default jumper settings.

Understanding Resistive Brake Module Connections

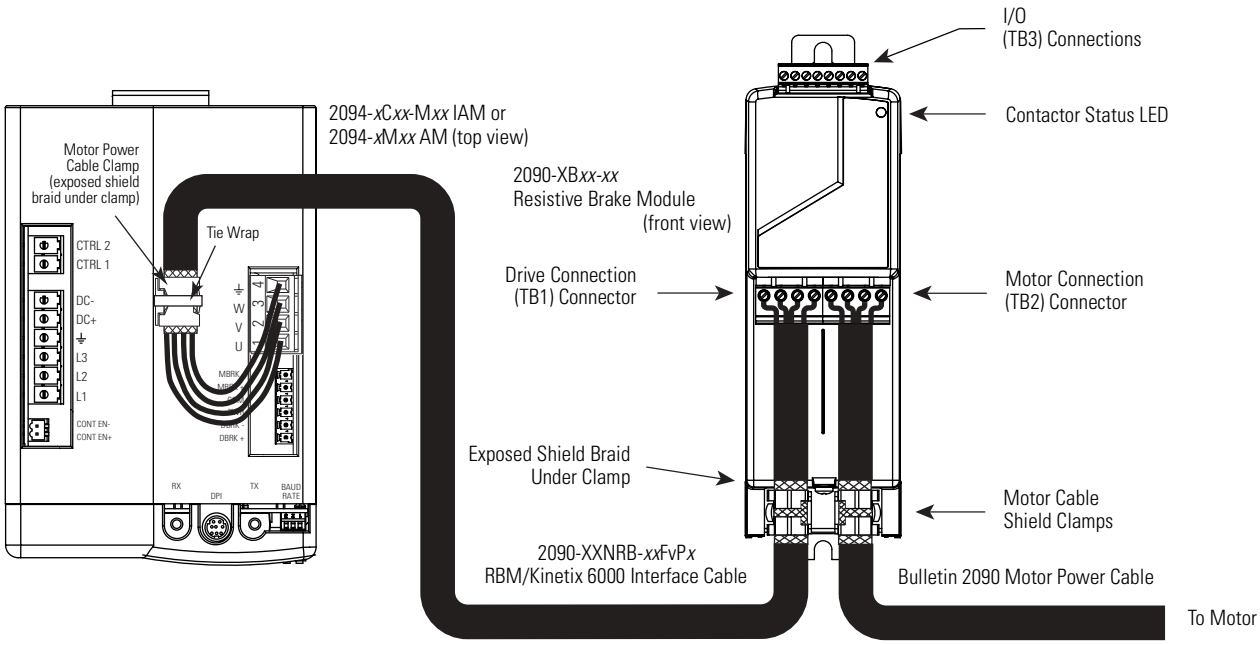
Follow these guidelines when wiring your Bulletin 2090 Resistive Brake Module (RBM).

IMPORTANT To ensure system performance, run wires and cables in the wireways as established in Chapter 2.

If your application requires an RBM and you are wiring to a Kinetix 6000 IAM/AM drive, then refer to the following:

- Resistive Brake Modules on page 42.
- Resistive brake module to Kinetix 6000 drive interface cable (catalog number 2090-XXNRB-*xx*F*x*P*x*).
- The The example diagram below shows Kinetix 6000 IAM, AM, and LIM (2094-ALxxS, -BLxxS, and -XL75S) wired with the Bulletin 2090 RBM in a category 2 configuration. in Appendix E.
- The installation instructions provided with your RBM, publication 2090-IN009.

Resistive Brake Module Connections



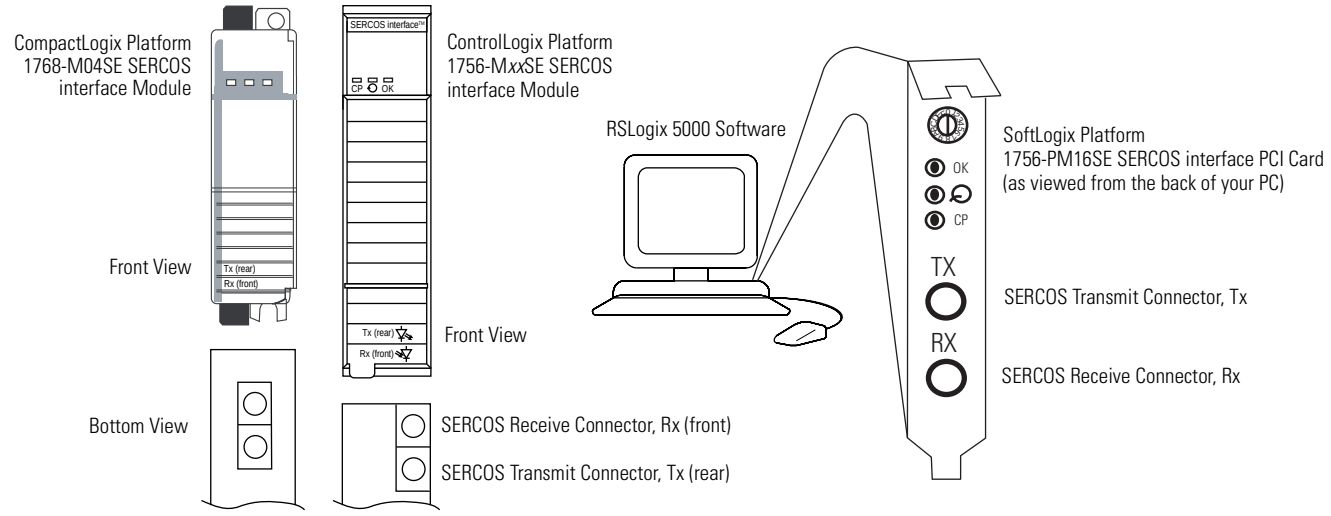
Connecting Your SERCOS Fiber-optic Cables

This procedure assumes you have your Logix SERCOS interface module/PCI card and Kinetix 6000 IAM/AM modules mounted and are ready to connect the fiber-optic cables.

The SERCOS fiber-optic ring is connected using the SERCOS receive (Rx) and transmit (Tx) connectors. Refer to page 50 to locate the SERCOS connectors on your Kinetix 6000 IAM/AM. Refer to the figure below to locate the connectors on your SERCOS interface module or PCI card.

Plastic cable is available in lengths up to 32 m (105.0 ft). Glass cable is available in lengths between 50 m (164.2 ft) and 200 m (656.7 ft).

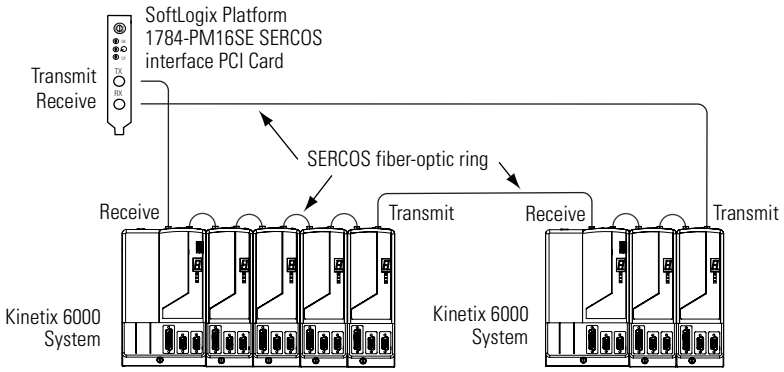
CompactLogix, ControlLogix, and SoftLogix SERCOS Connector Locations



Connect the cable from transmit on the Logix module to receive on the IAM, then transmit to receive (drive to drive), and from transmit on the last drive back to receive on the Logix module.

SoftLogix and ControlLogix platforms are used in the examples beginning below, however, all platforms connect in the same manner.

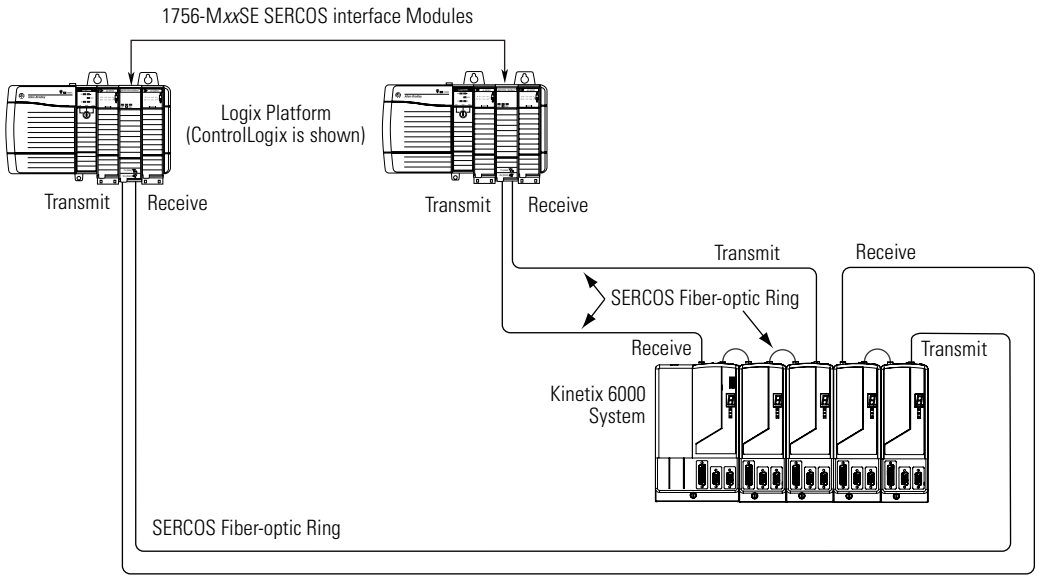
Fiber-optic Cable Example 1 (basic SERCOS ring connections)



IMPORTANT The CompactLogix platform (1768-M04SE) is limited to four axes per module.

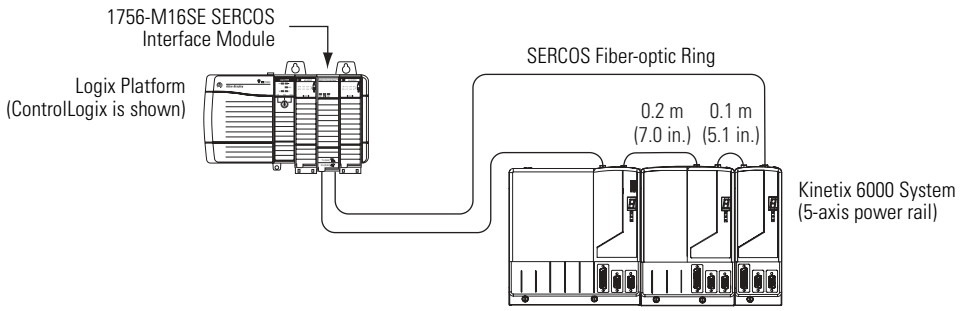
In this example, two Logix modules are installed in separate Logix chassis.

Fiber-optic Cable Example 2 (two Logix chassis)



When connecting 2094-BM03 and -BM05 (double-wide) axis modules, use 2090-SCEP0-2, 0.2 m (7.0 in.) cables. When connecting 2094-AM*xx*, -BMP5, -BM01 and -BM02 (single-wide) axis modules, use 2090-SCEP0-1, 0.1 m (5.1 in.) cables.

Fiber-optic Cable Example 3 (double-wide modules)

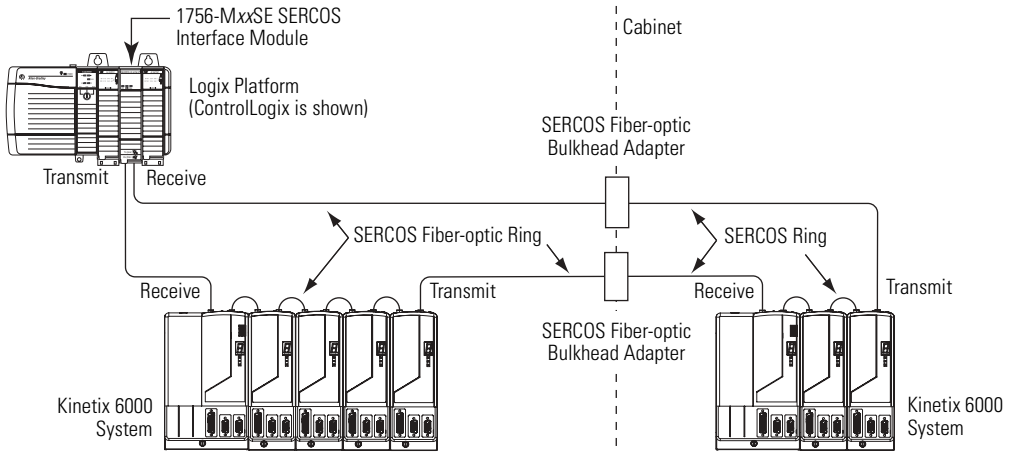


IMPORTANT Clean the fiber-optic cable connectors prior to installation. Dust in the connectors can reduce signal strength. For more information, refer to Fiber-optic Cable Installation and Handling Instructions, publication 2090-IN010.

In this example, the second Kinetix 6000 system is located in a separate cabinet and connected with bulkhead adapters.

IMPORTANT To avoid signal loss, do not use bulkhead adapters to connect glass cables. Only use bulkhead adapters for making plastic-to-plastic cable connections.

Fiber-optic Cable Example 4 (bulkhead adapters)



Configure and Startup the Kinetix 6000 Drive System

Introduction

This chapter provides procedures for configuring your Kinetix 6000 system components with your Logix SERCOS module.

Configure the IAM/AM

Follow these steps to configure the IAM/AM.

1. Verify that there is no power applied to the IAM/AM and that the SERCOS fiber-optic cables are plugged into the Tx and Rx connectors.

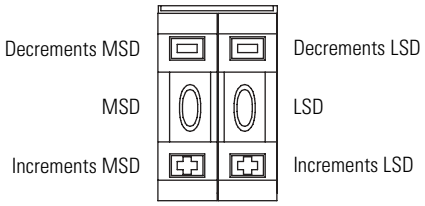
   To verify your fiber-optic cable connections, refer to Connecting Your SERCOS Fiber-optic Cables on page 115.

To Configure	Begin With
The integrated axis module (IAM)	Step 2
An axis module (AM)	Step 4

2. Set the base node address for the IAM by setting the SERCOS Node Address switch.

   Valid node addresses are 01...99. The left hand switch sets the most significant digit (MSD) and the right hand switch sets the least significant digit (LSD).

To	Press
Increment the (MSD/LSD) node address	The plus (+) switch.
Decrement the (MSD/LSD) node address	The minus (-) switch.



   Setting the base node address on the IAM determines the node address for the IAM inverter. Node addressing for all slot locations on the same power rail increment (from the IAM inverter) left to right.

3. Cycle control power to initialize the IAM.

IMPORTANT The base node address setting only takes effect after the IAM is initialized.

IMPORTANT When two or more IAMs are connected to the same SERCOS interface module, each node address must be unique.

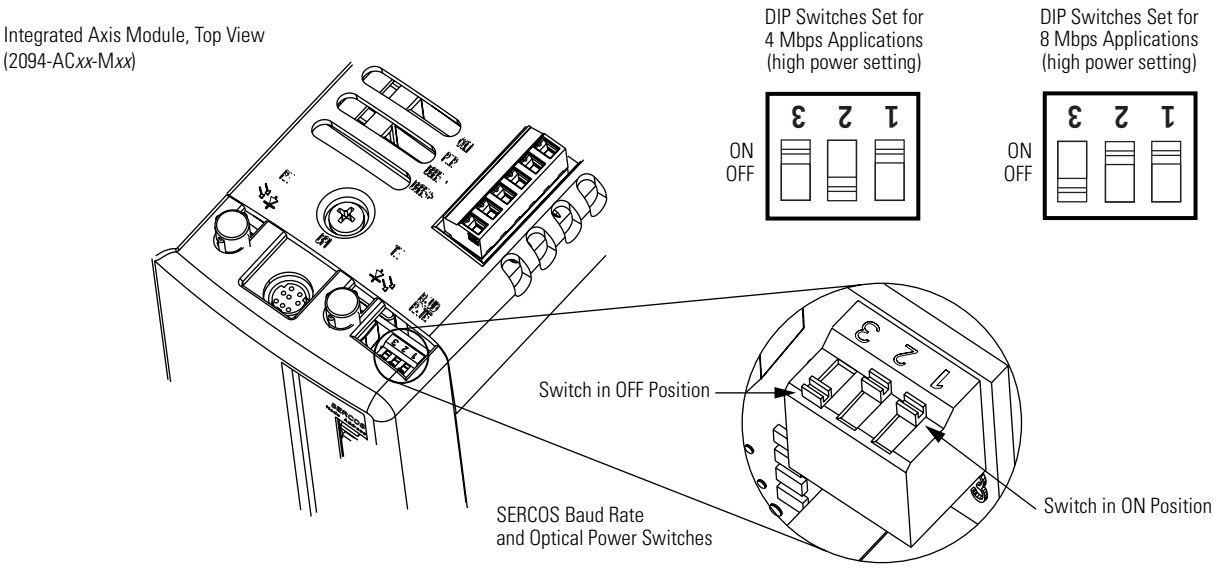
Refer to the node addressing examples on pages 122 and 124.

4. Set the SERCOS baud rate using DIP switches 2 and 3.

For This Baud Rate	Set Switch 2	Set Switch 3
4 Mbps	OFF	ON
8 Mbps	ON	OFF

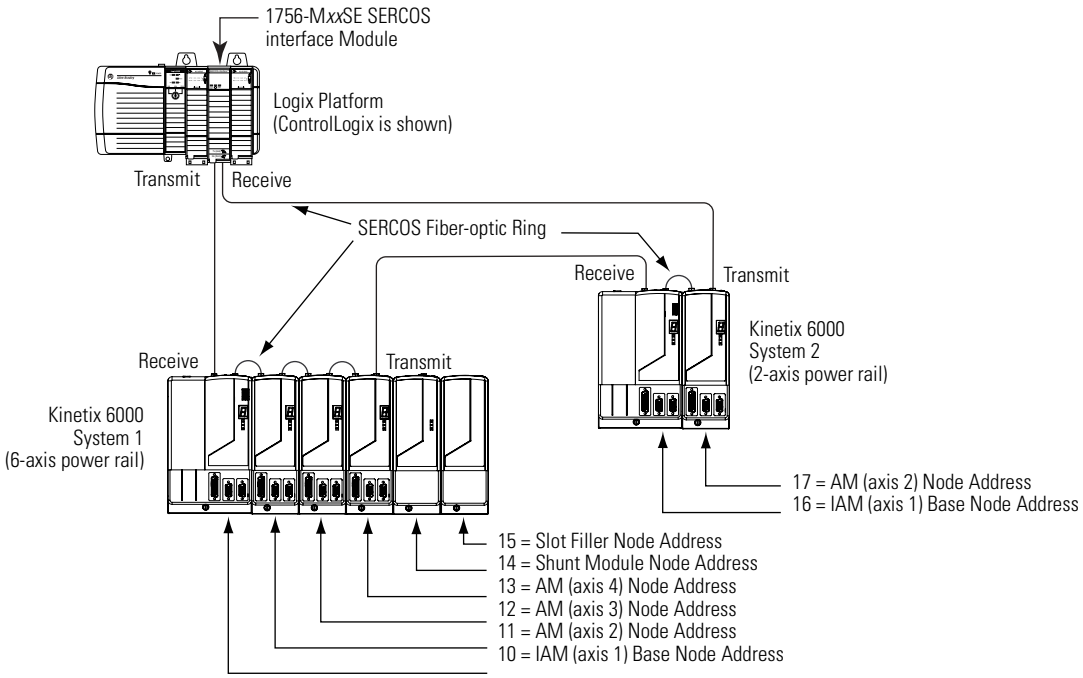
5. Set the SERCOS optical power level to High using DIP switch 1.

For This Optical Power Level	Set Switch 1
Low	OFF
High	ON



6. Repeat Steps 4 and 5 for each 2094-*x*M*xx* axis module.

Node Addressing Example 1



In Example 1, the Kinetix 6000 (6-axis) System 1 power rail contains one IAM, three AMs, one SM, and one slot filler module. The shunt module and slot filler modules are assigned a node address, but they do not use it.

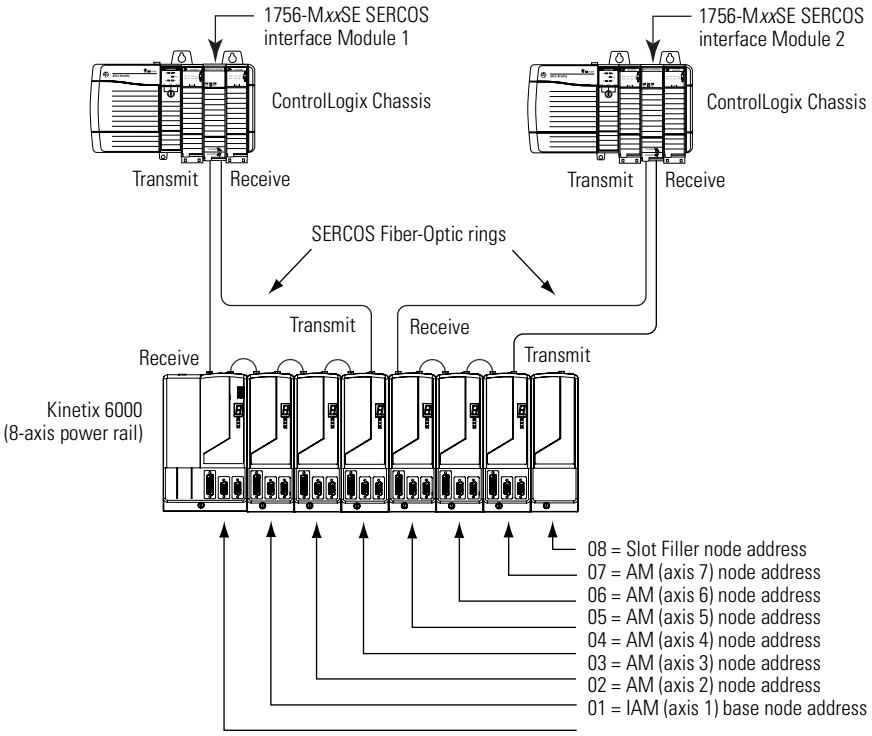
Kinetix 6000 (2-axis) System 2 power rail contains one IAM and one AM. The base node address of the IAM (system 2) must be set for an address of ≥16 or ≤8.

IMPORTANT The node address for each axis module is determined by the base node-address switch setting on the IAM.

Do not position axis modules to the right of shunt or slot filler modules. The added distance between non-adjacent axes can increase electrical noise and impedance, and requires longer fiber-optic cable lengths.

IMPORTANT Slot filler modules must be used to fill any unoccupied slot on the power rail. However, the slot fillers may also be removed and replaced by an axis or shunt module in the future.

Node Addressing Example 2



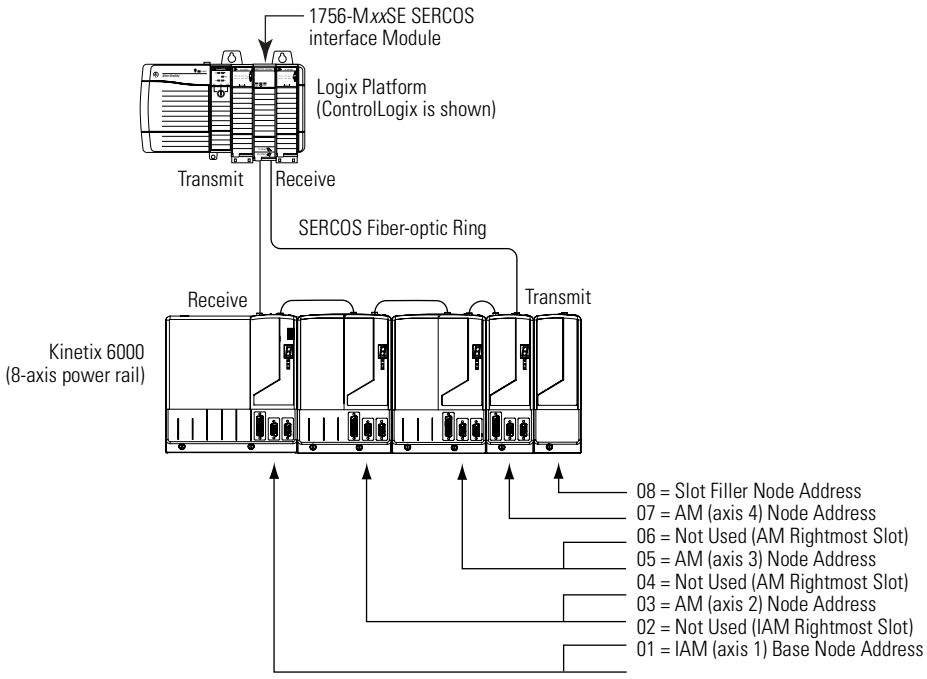
In the example above, SERCOS interface module 1 controls axes 1 to 4 and module 2 controls axes 5 to 7. The slot filler module is assigned a node address, but does not use it.

You can mount the two SERCOS interface modules in two separate ControlLogix chassis (as shown above) or you can mount them in the same chassis.

Utilizing two SERCOS interface modules to control axes from a single Kinetix 6000 power rail allows you to reduce the cycle times.

IMPORTANT Slot Filler modules must be used to fill any unoccupied slot on the power rail. However, the slot fillers may also be removed and replaced by an axis or shunt module in the future.

Node Addressing Example 3



In Example 2, the Kinetix 6000 (8-axis) power rail contains a double-wide IAM, two double-wide AMs, one single-wide AM, and one slot filler module. The slot filler module is assigned a node address, but does not use it.

The leftmost slot of a double-wide module determines the node address. So, in the example above, node addresses 02, 04, and 06 (the rightmost slots of the double-wide modules) are not used.

IMPORTANT Slot filler modules must be used to fill any unoccupied slot on the power rail. However, the slot fillers may also be removed and replaced by an axis or shunt module in the future.

IMPORTANT Do not position axis modules to the right of shunt or slot filler modules. The added distance between non-adjacent axes can increase electrical noise and impedance, and requires longer fiber-optic cable lengths.

Configure the Logix SERCOS interface Module

This procedure assumes that you have wired your Kinetix 6000 system and have configured the baud rate and optical power switches.

IMPORTANT In order for the Kinetix 6000 drive to communicate with the SERCOS interface module (indicated by the three LED indicators on the module going solid green), your RSLogix 5000 software must be revision 11.0 or later.

For greater detail on the RSLogix 5000 software as it applies to configuring the ControlLogix, CompactLogix, or SoftLogix SERCOS modules, refer to Additional Resources on page 10.

Configure the Logix Controller

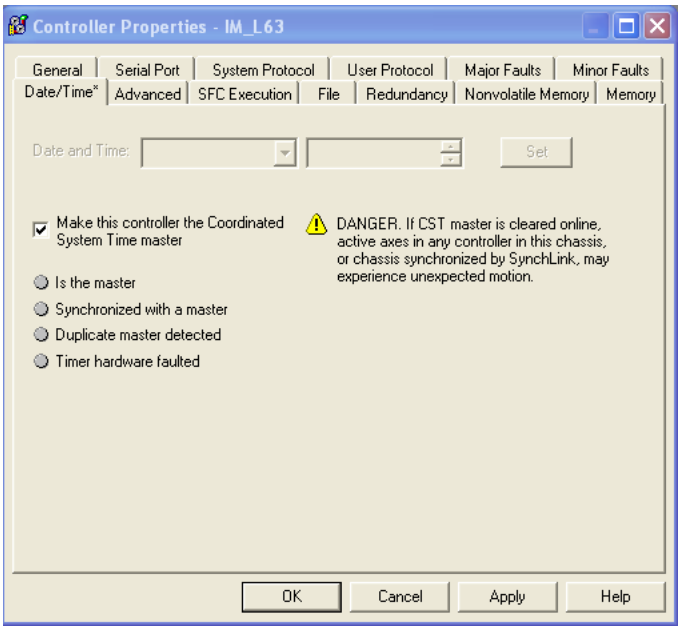
Follow these steps to configure the Logix controller.

1. Apply power to your Logix chassis/personal computer containing the SERCOS interface module and open your RSLogix 5000 software.
2. From the File menu, choose New.

   The New Controller dialog opens.
3. Configure the new controller.
   a. Select controller type.
   b. Select RSLogix 5000 software revision.
   c. Name the file.
   d. Select the Logix chassis size.
   e. Select the Logix processor slot.
4. Click OK.
5. From the Edit menu, choose Controller Properties.

   The Controller Properties dialog opens.

6. Select the Date and Time tab.



7. Check the box Make this controller the Coordinated System Time master.

IMPORTANT Only one ControlLogix processor can be assigned as the Coordinated System Time master.

8. Click OK.

Configure the Logix Module

Follow these steps to configure the Logix module.

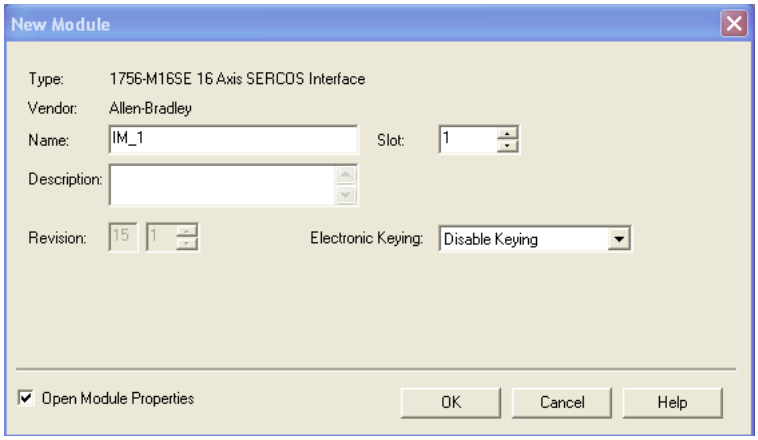
1. Right-click on I/O Configuration in the explorer dialog and select New Module.

   The Select Module dialog opens.

2. Expand the Motion category and select 1756-M*xx*SE, -L60M03SE, 1768-M04SE, or 1784-PM16SE as appropriate for your actual hardware configuration.

3. Click OK.

The New Module dialog opens. Your new module appears under the I/O Configuration folder in the explorer dialog.



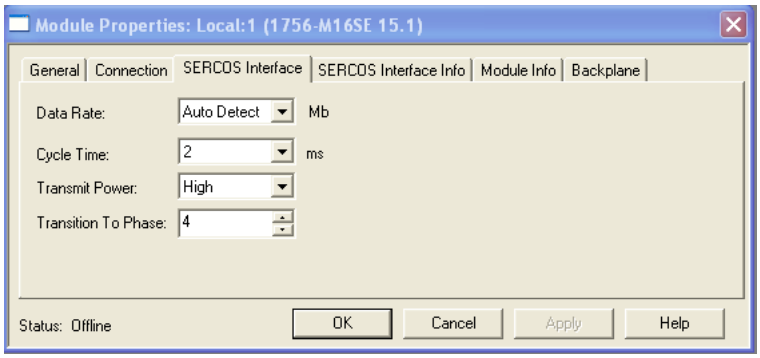
4. Configure the new module.

   a. Name the module.
   b. Select the slot where your module resides (leftmost slot = 0).
   c. Select an Electronic Keying option (select Disable Keying if unsure).
   d. Check the box Open Module Properties.

5. Click OK.

   The Module Properties dialog opens.

6. Select the SERCOS Interface tab and reference the table below.



Logix SERCOS Module	Number of Axes	Data Rate
1756-M03SE or 1756-L60M03SE	Up to 3	4 or 8 Mbps
1756-M08SE	Up to 8	
1756-M16SE or 1784-PM16SE	Up to 16	
1768-M04SE	Up to 4	

7. Verify that the Data Rate setting matches DIP switches 2 and 3 (baud rate) as set on the IAM and AMs, or use the Auto Detect setting.

8. Set the Cycle Time according to the table below.

Data Rate	Number of Axes	Cycle Time
4 Mbps	up to 2	0.5 ms
	up to 4	1 ms
	up to 8	2 ms
	No support for axes 9...16	
8 Mbps	up to 4	0.5 ms
	up to 8	1 ms
	up to 16	2 ms

   The number of axes/module is limited to the number of axes as shown in Step 6.

9. Verify that the Optical Power setting (high or low) matches DIP switch 1 as set on the IAM and AMs.

10. Set Transition to Phase.

    Transition to Phase default setting is 4 (phase 4). The Transition to Phase setting will stop the ring in the phase specified.

11. Click OK.

12. Repeat steps 1...11 for each Logix module.

Configure the Kinetix 6000 Modules

Follow these steps to configure the Kinetix 6000 modules.

1. Right-click the new Logix module you just created and select New Module.

   The Select Module dialog opens.

2. Expand the Drives category and select your 2094-*x*C*xx*-M*xx* (IAM) or 2094-*x*M*xx* (AM) as appropriate for your actual hardware configuration.

3. Click OK.

   The New Module dialog opens.

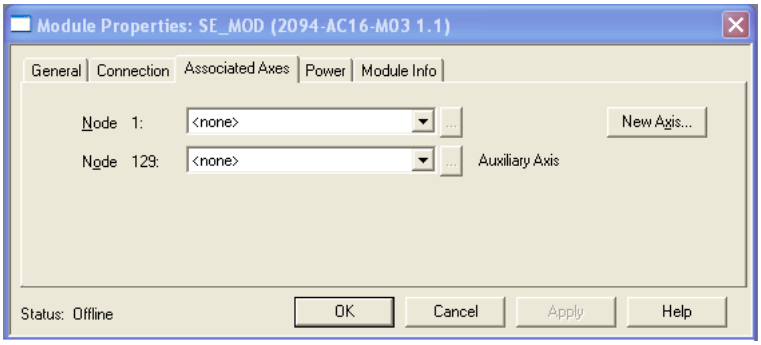
   a. Name the module.
   b. Set the Node address.

   Set the node address in the software to match the node setting on the drive. Refer to Configure the IAM/AM, Step 2, on page 120.

   c. Select an Electronic Keying option.
   d. Check the box Open Module Properties.

4. Click OK.

5. Select the Associated Axes tab.



6. Click the New Axis button.

   The New Tag dialog opens.

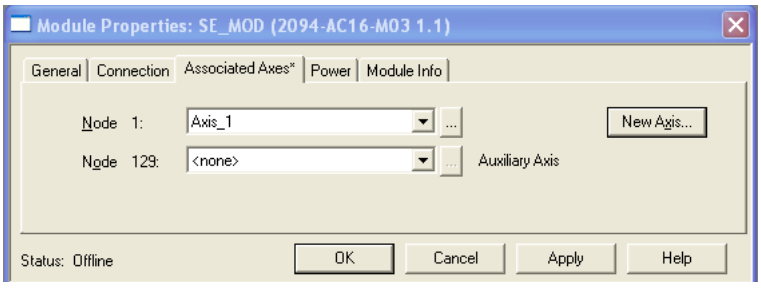
7. Add the axis.

   a. Name the axis.
   b. Select AXIS_SERVO_DRIVE as the Data Type.

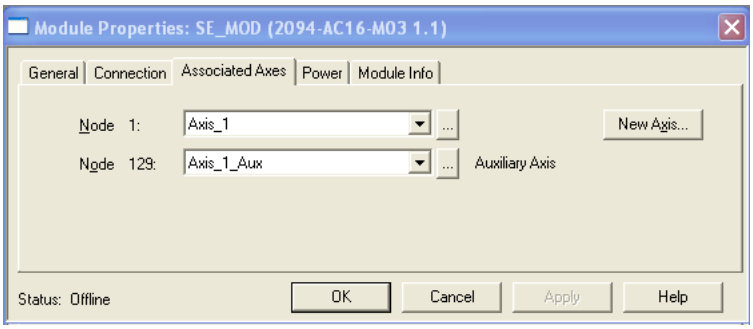
8. Click OK.

   The axis appears under the Ungrouped Axes folder in the explorer dialog.

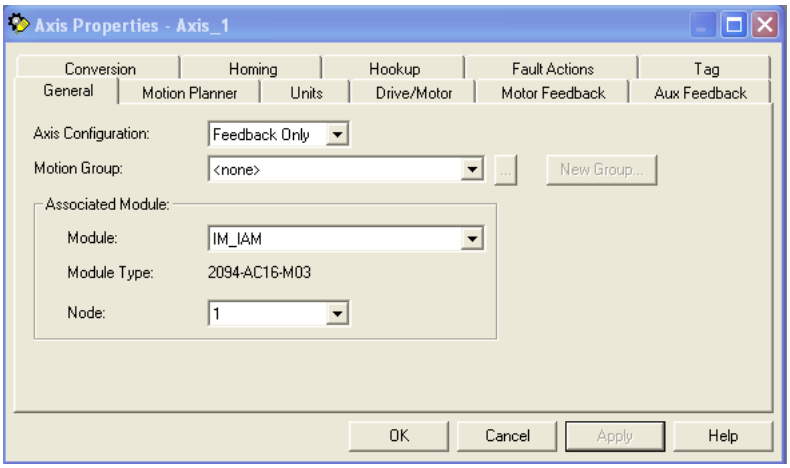
9. Assign your axis to the node address (as shown in the dialog below).



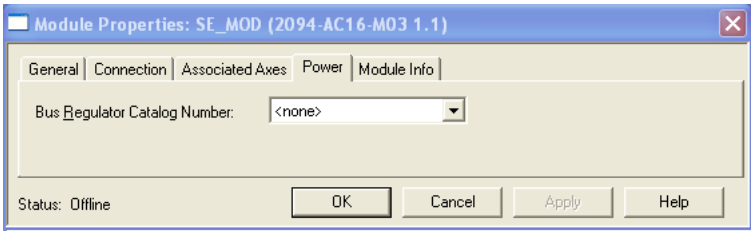
With drive firmware revision 1.80 or later, and RSLogix 5000 software revision 13 or later, it is possible to configure the auxiliary axis feedback port as a Feedback Only axis. With this feature, each IAM (inverter) or AM can be configured to appear as two axes/nodes on the SERCOS ring. The base node is the servo axis utilizing the motor feedback, and the base node (plus 128) is a feedback only axis utilizing the auxiliary feedback port (as shown below).



If an axis is associated to the auxiliary axis node, then the Axis Configuration on the General tab of the Axis Properties dialog is set to Feedback Only (as shown below).



10. Select the Power tab.



11. Select the Bus Regulator Catalog Number or other as appropriate for your actual hardware configuration.

If your IAM is	And your hardware configuration includes this shunt option	Then select
Configured as an IAM or Leader IAM (common bus) [1]	Internal shunts only	Internal or <none>
	Bulletin 2094 (rail mounted) shunt module	2094-BSP2
	Bulletin 1394 passive shunt module (connected to the 2094-BSP2)	1394-SR*xxxx*
	Bulletin 1336 active shunt module	Internal or <none>
Configured as a Follower IAM [2]	N/A. Shunts are disabled on Follower IAM	CommonBus Follow

[1] Drive will not accept Internal, <none>, 2094-BSP2, or 1394-SR*xxxx* selection if dc bus voltage is present without having three-phase power applied.

[2] Drive will not accept CommonBus Follow selection if three-phase power is applied.

ATTENTION

To avoid damage to your Bulletin 1394 external shunt module, verify that the proper 230V or 460V fuse is installed prior to applying power.

Refer to Circuit Breaker/Fuse Specifications on page 177, for more information.

IMPORTANT When configured to use the Bulletin 1394 or 2094 shunt modules, the IAM bus regulator capacity attribute displays the shunt module or passive shunt module utilization instead of the IAM internal shunt resistor utilization.

IMPORTANT DC common bus applications must calculate Total Bus Capacitance and Additional Bus Capacitance and set the Add Bus Cap parameter (*x:x:x*599) using DriveExplorer software.

Refer to the Appendix D beginning on page 231, for more information.

12. Click OK.

13. Repeat steps 1...9 for each 2094-*x*M*xx* axis module.

Configure the Motion Group

Follow these steps to configure the motion group.

1. Right-click Motion Groups in the explorer dialog and select New Motion Group.

   The New Tag dialog opens.

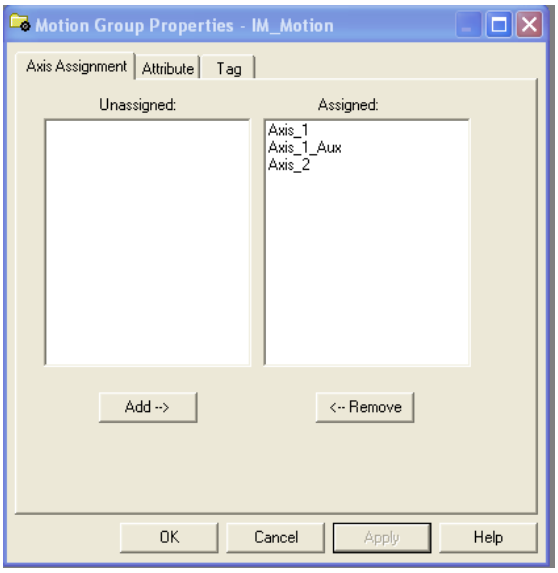
2. Name the new motion group.

3. Click OK.

   New group appears under the Motion Groups folder.

4. Right-click the new motion group and select Properties.

   The Motion Group Properties dialog opens.



5. Select the Axis Assignment tab and move your axes (created earlier) from Unassigned to Assigned.

6. Select the Attribute tab and edit the default values as appropriate for your application.

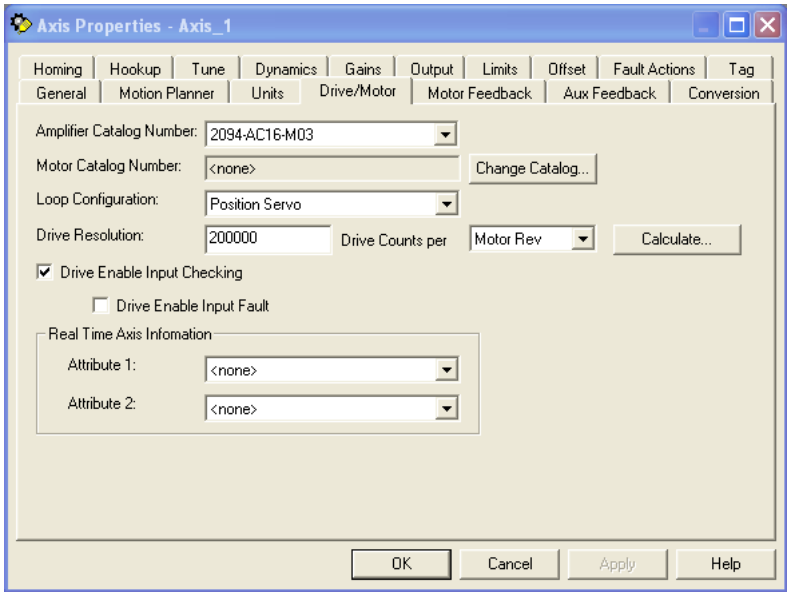
7. Click OK.

Configure Axis Properties

Follow these steps to configure axis properties.

1. Right-click on an axis in the explorer dialog and select Properties.

   The Axis Properties dialog opens.



2. Select the Drive/Motor tab and edit the default values as appropriate for your application.

   a. Set the Kinetix 6000 Amplifier (2094-*x*C*xx*-M*xx*).

   b. Set the Motor Catalog Number.

   For amplifier and motor catalog numbers refer to the amplifier and motor name plate.

   c. Set Drive Enable Input Checking.

   When checked (default), means a hard drive-enable input signal is required. Uncheck to remove that requirement.

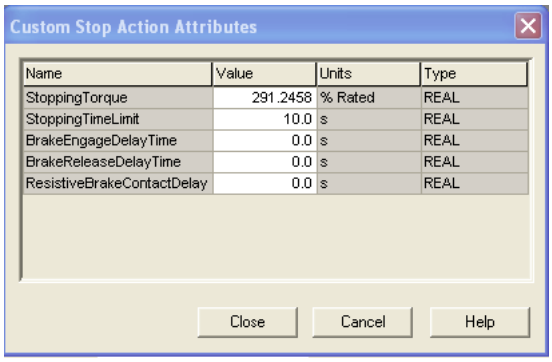
3. Select the Motor Feedback tab and verify the Feedback Type shown is appropriate for your actual hardware configuration.

4. Select the Units tab and edit default values as appropriate for your application.

5. Select the Conversion tab and edit default values as appropriate for your application.

6. Select the Fault Actions tab and click the Set Custom Stop Action... tab.

The Custom Stop Action Attributes dialog opens.



The Custom Stop Action Attributes window lets you set delay times for servo motors and resistive brake modules. For recommended motor brake delay times, refer to the Kinetix Motion Control Selection Guide, publication GMC-SG001.

7. Configure the delay times.

a. Set the Brake Engage Delay Time.

b. Set the Brake Release Delay Time.

c. Set the Resistive Brake Contact Delay time (0 - 1000 ms range).

TIP

The recommended delay time for 2090-XB33-*xx* and -XB120-*xx* resistive brake modules is 71 ms.

If you are using RSLogix 5000 v12 or earlier, refer to Setting the RBM Delay Time Using DriveExplorer on page 252.

d. Click Close.

8. Click OK.

9. Repeat steps 1...8 for each 2094-*x*M*xx* axis module.

10. Verify your Logix program and save the file.

Download the Program

After completing the Logix configuration you must download your program to the Logix processor.

Apply Power to the Kinetix 6000 Drive

This procedure assumes that you have wired and configured your Kinetix 6000 system (with or without the LIM) and your SERCOS interface module.

SHOCK HAZARD

To avoid hazard of electrical shock, perform all mounting and wiring of IAM, AM, SM, LIM, RBM, or power rail prior to applying power. Once power is applied, connector terminals may have voltage present even when not in use.

Refer to the Line Interface Module Installation Instructions, publication 2094-IN005, when troubleshooting the LIM status indicators, and for the location of LIM circuit breakers, connectors, and status indicators.

Follow these steps to apply power to the Kinetix 6000 system.

1. Disconnect the load to the motor.

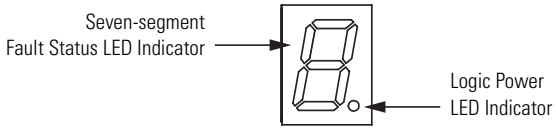
ATTENTION

To avoid personal injury or damage to equipment, disconnect the load to the motor. Make sure each motor is free of all linkages when initially applying power to the system.

2. Determine your source of control power.

If Your Control Power	Then
Is sourced from a LIM	1. Verify that CB1, CB2, and CB3 are in the OFF position. 2. Apply three-phase input power to the LIM VAC Line connector. 3. Set CB3 to the ON position. 4. Set CB2 to the ON position. 5. Go to main Step 3.
Is not sourced from a LIM	1. Apply (95...264V ac) control power to the IAM (CPD connector). 2. Go to main Step 3.

3. Observe the IAM/AM logic power LED indicator.



If the Logic Power LED Indicator is	Then
ON	Go to Step 4.
Not ON	1. Check your control power connections. 2. Go back to main Step 2.

4. Determine your source of three-phase input power.

If Your Three-phase Power	Then
Is sourced from a LIM	1. Set CB1 to the ON position. 2. Verify the Hardware Enable Input signal (IOD pin 2) for each axis is at 0 volts. Remove the connection between IOD-1 and IOD-2 if one exists. 3. Go to main Step 5.
Is not sourced from a LIM	1. Apply 195...265V ac (230V) or 324...528V ac (460V) input power to the IAM (IPD connector). 2. Verify the Hardware Enable Input signal (IOD pin 2) for each axis is at 0 volts. Remove the connection between IOD-1 and IOD-2 if one exists. 3. Go to main Step 5.

5. Observe the IAM/AM fault status LED indicator.

The status LED indicator will first flash the SERCOS node address, then cycle through phases until final configuration (phase 4) is reached.

IAM/AM Fault Status LED Indicator	Status	Do This
Actively cycling (phase 0)	The drive is looking for a closed SERCOS ring. Wait for phase 1 or take corrective action until you reach phase 1.	Check fiber-optic connections.
Displaying a fixed 1 (phase 1)	The drive is looking for active nodes. Wait for phase 2 or take corrective action until you reach phase 2.	Check node addressing.
Displaying a fixed 2 (phase 2)	The drive is configuring nodes for communication. Wait for phase 3 or take corrective action until you reach phase 3.	Check program motor and drive configuration against installed hardware.
Displaying a fixed 3 (phase 3)	The drive is configuring device specific parameters. Wait for phase 4 or take corrective action until you reach phase 4.	Check motor catalog number against selection. (1)
Displaying a fixed 4 (phase 4)	The drive is configured and active.	Go to Step 6.
Flashing an E followed by two numbers	Drive is faulted.	Go to Error Codes on page 146.

(1) You can get diagnostic information from the module by highlighting the module name in RSLogix 5000 software. A Pseudo Key Failure often indicates that the motor selection does not match the motor installed.

6. Observe the three status LED indicators on the front of the IAM/AM.

Status LED Indicator	Condition	Status	Do This
Drive	Off	Normal condition	Observe the Comm Status LED indicator.
	Steady red	Drive is faulted	Go to IAM/AM Status Indicators on page 152.
Comm	Flashing green	Establishing communication with network	Wait for steady green.
	Steady green	Communication is ready	Observe the Bus Status LED indicator.
	Off	No ring present	Go to IAM/AM Status Indicators on page 152.
Bus	Steady green	Axis is enabled when status should be disabled	1. Verify Hardware Enable Input (IOD-2) is open. 2. Verify MSO instruction is not commanded in RSLogix 5000 software. 3. Return to Apply Power to the Kinetix 6000 Drive on page 135.
	Flashing green (1)	Bus is up, axis is disabled (normal status)	Go to Step 7.
	Off	DC bus is not present	Go to IAM/AM Status Indicators on page 152.

(1) The follower IAM has a 2.5 second delay after dc bus voltage is applied before the Bus Status LED begins flashing. This provides the common bus leader time to complete pre-charge.

7. Observe the three SERCOS LED indicators on the SERCOS module.

Three SERCOS LED Indicators	Status	Do This
Flashing green and red	Establishing communication	Wait for steady green on all three LED indicators.
Steady green	Communication ready	Go to Test and Tune the Axes.
Not flashing green and red/ not steady green	SERCOS module is faulted	Go to the appropriate Logix manual for specific instructions and troubleshooting.

Test and Tune the Axes

This procedure assumes that you have configured your Kinetix 6000 drive, your SERCOS interface module, and applied power to the system.

IMPORTANT Before proceeding with testing and tuning your axes, verify that the IAM and AM seven-segment and status LED indicators are as described in Step 6 on page 137.

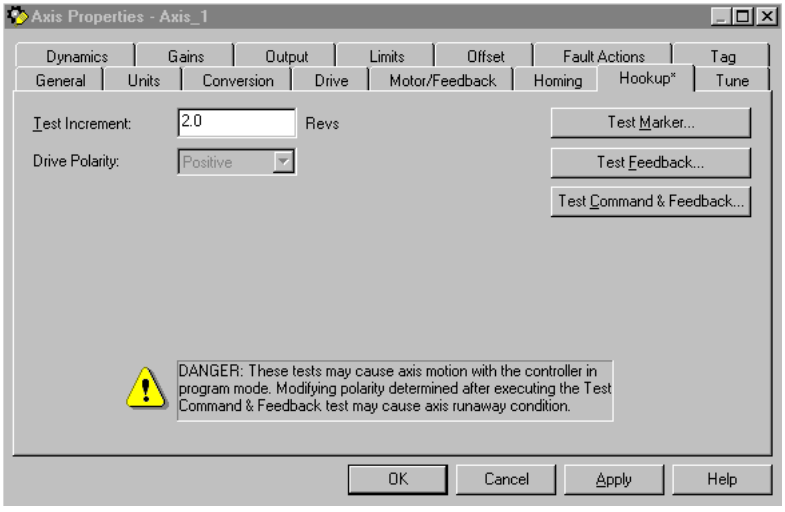
For help using RSLogix 5000 software as it applies to testing and tuning your axes with ControlLogix, CompactLogix, or SoftLogix SERCOS modules, refer to Additional Resources on page 10.

Test the Axes

Follow these steps to test the axes.

1. Verify the load was removed from each axis.
2. Right-click an axis in your Motion Group folder in the explorer dialog and select Axis Properties.

   The Axis Properties dialog appears.
3. Select the Hookup tab.



4. Select 2.0 as the number of revolutions for the test (or another number more appropriate for your application).

This Test	Performs this Test
Test Marker	Verifies marker detection capability as you rotate the motor shaft.
Test Feedback	Verifies feedback connections are wired correctly as you rotate the motor shaft.
Test Command & Feedback	Verifies motor power and feedback connections are wired correctly as you command the motor to rotate. Also, lets you define polarity.

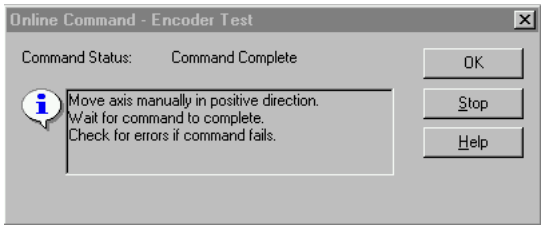
5. Apply Hardware Enable Input signal (IOD-2) for the axis you are testing.

ATTENTION

To avoid personal injury or damage to equipment, apply 24V ENABLE signal (IOD-2) only to the axis you are testing.

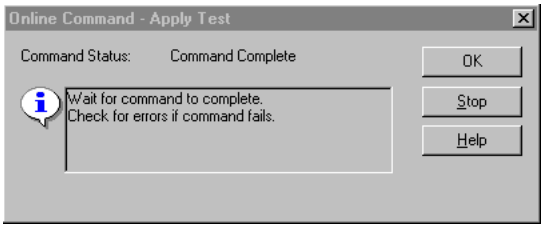
6. Select the Test (Marker/Feedback/Command & Feedback) button to verify connections.

   The Online Command dialog opens. Follow the on-screen test instructions. When the test completes, the Command Status changes from Executing to Command Complete.



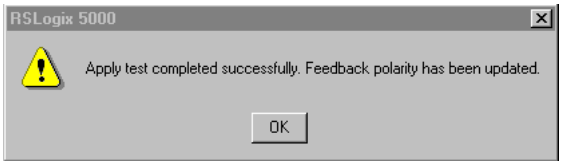
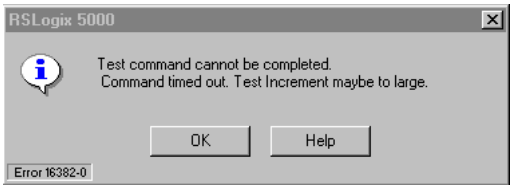
7. Click OK.

   The Online Command - Apply Test dialog opens (Feedback and Command & Feedback tests only). When the test completes, the Command Status changes from Executing to Command Complete.



8. Click OK.

9. Determine if your test completed successfully.

If	Then
Your test completes successfully, this dialog appears. 	1. Click OK. 2. Remove Hardware Enable Input signal (IOD-2). 3. Go to Tune the Axes.
Your test failed, this dialog appears. 	1. Click OK. 2. Verify the Bus Status LED turned solid green during the test. 3. Verify that the Hardware Enable Input signal (IOD-2) is applied to the axis you are testing. 4. Verify conversion constant entered in the Conversion tab. 5. Return to main Step 6 and run the test again.

Tune the Axes

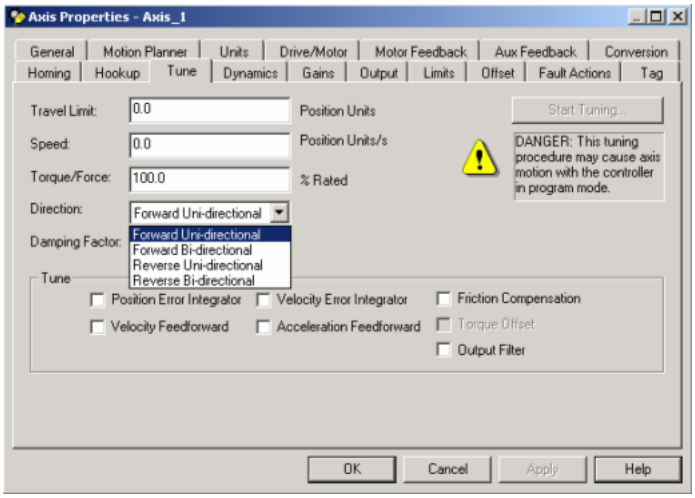
Follow these steps to tune the axes.

1. Verify the load is still removed from the axis being tuned.

ATTENTION

To reduce the possibility of unpredictable motor response, tune your motor with the load removed first, then re-attach the load and perform the tuning procedure again to provide an accurate operational response.

2. Select the Tune tab.



3. Enter values for Travel Limit and Speed. In this example, Travel Limit = 5 and Speed = 10.

   Actual value of programmed units depend on your application.

4. Select setting for Direction (Forward Uni-directional is default).

5. Check Tune boxes as appropriate for your application.

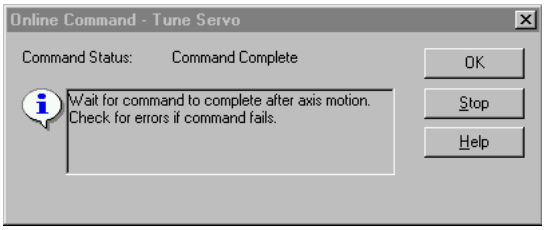
6. Apply Hardware Enable Input signal (IOD-2) for the axis you are tuning.

ATTENTION

To avoid personal injury or damage to equipment, apply 24V ENABLE signal (IOD-2) only to the axis you are tuning.

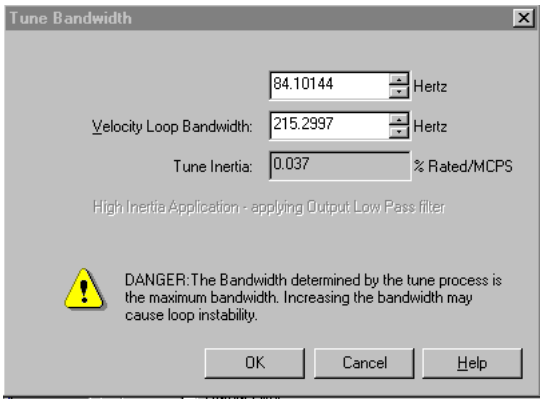
7. Select the Start Tuning button to auto-tune your axis.

The Online Command - Tune Servo dialog opens. When the test completes, the Command Status changes from Executing to Command Complete.



8. Click OK.

The Tune Bandwidth dialog opens.

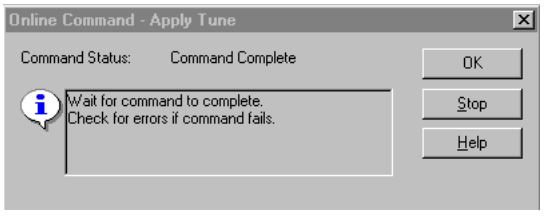


Actual bandwidth values (Hz) depend on your application and may require adjustment once motor and load are connected.

Record your bandwidth data for future reference.

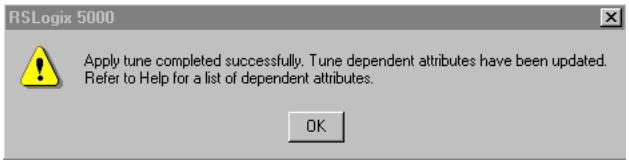
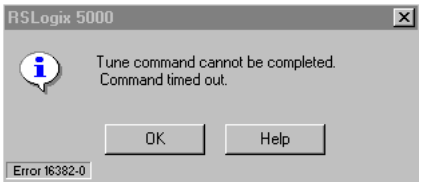
9. Click OK.

The Online Command - Apply Tune dialog opens. When the test completes, the Command Status changes from Executing to Command Complete.



10. Click OK.

11. Determine if your test completed successfully.

If	Then
Your test completes successfully, this dialog appears. 	1. Click OK. 2. Remove the Hardware Enable Input signal (IOD-2) applied earlier. 3. Go to Step 12.
Your test failed, this dialog appears. 	1. Click OK. 2. Make an adjustment to motor velocity. 3. Refer to appropriate Logix motion module setup and configuration manual for more information. 4. Return to Step 7 and run the test again.

12. Repeat Test and Tune the Axes for each axis.

Troubleshooting the Kinetix 6000 Drive System

Introduction

This chapter provides troubleshooting tables and for your Kinetix 6000 system components.

Safety Precautions

Observe the following safety precautions when troubleshooting your Kinetix 6000 drive.

ATTENTION

Capacitors on the dc bus may retain hazardous voltages after input power has been removed. Before working on the drive, measure the dc bus voltage to verify it has reached a safe level or wait the full time interval as indicated in the warning on the front of the drive. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION

Do not attempt to defeat or override the drive fault circuits. You must determine the cause of a fault and correct it before you attempt to operate the system. Failure to correct the fault could result in personal injury and/or damage to equipment as a result of uncontrolled machine operation.

ATTENTION

Provide an earth ground for test equipment (oscilloscope) used in troubleshooting. Failure to ground the test equipment could result in personal injury.

Interpreting Status Indicators

Refer to these troubleshooting tables to identify faults, potential causes, and the appropriate actions to resolve the fault. If the fault persists after attempting to troubleshoot the system, please contact your Rockwell Automation sales representative for further assistance.

Error Codes

The following list of problematic symptoms (no error code shown) and faults with assigned error codes is designed to help you resolve anomalies.

When a fault is detected, the seven-segment LED indicator will display an E followed by the flashing of the two-digit error code, one digit at a time. This is repeated until the error code is cleared.

Seven-segment LED Indicator Error Codes

Error Code	Fault Message **RSLogix** (HIM)	Problem or Symptom	Potential Cause	Possible Resolution
		Power (PWR) indicator not ON	No ac power or auxiliary logic power.	Verify ac control power is applied to the Kinetix 6000 system.
			Internal power supply malfunction.	Call your Rockwell Automation sales representative to return module for repair.
		Motor jumps when first enabled	Motor wiring error.	• Check motor wiring. • Run Hookup test in RSLogix 5000 software.
			Incorrect motor chosen.	Verify the proper motor is selected.
		Digital I/O not working correctly	I/O power supply disconnected.	Verify connections and I/O power source.
E00	**BusUndervoltage Fault** (Blown fuse)	A blown fuse was detected on the inverter PCB	Blown fuse.	Call your Rockwell Automation sales representative to return module for repair.
E04	**MotorOvertemp Fault** (Motor Overtemp)	Motor thermal switch tripped	• High motor ambient temperature and/or • Excessive current	• Operate within (not above) the continuous torque rating for the ambient temperature 40 °C (104 °F) maximum. • Lower ambient temperature, increase motor cooling.
			Motor wiring error.	Check motor wiring at MF connector on the IAM/AM.
			Incorrect motor selection.	Verify the proper motor has been selected.

Error Code	Fault Message RSLogix (HIM)	Problem or Symptom	Potential Cause	Possible Resolution
E05	**DriveOvercurrent Fault** (Power Fault)	Self-protection of the Intelligent Power Module (IPM) is indicating a major power related fault condition.	Motor cables shorted.	Verify continuity of motor power cable and connector.
			Motor winding shorted internally.	Disconnect motor power cables from the motor. If the motor is difficult to turn by hand, it may need to be replaced.
			Kinetix 6000 temperature too high.	• Check for clogged vents or defective fan. • Make sure cooling is not restricted by insufficient space around the unit.
			Operation above continuous power rating and/or product environmental ratings.	• Verify ambient temperature is not too high. • Operate within the continuous power rating. • Reduce acceleration rates.
			Kinetix 6000 has a short circuit, overcurrent, or failed component.	Remove all power and motor connections, and preform a continuity check from the dc bus to the U, V, and W motor outputs. If a continuity exists, check for wire fibers between terminals, or send drive in for repair.
E06	**HardOvertravel Fault** (+/- Hard Overtravel)	Axis moved beyond the physical travel limits in the positive/negative direction.	Dedicated overtravel input is inactive.	• Check wiring. • Verify motion profile. • Verify axis configuration in software.
E07	**MotFeedbackFault** (Motor Feedback Loss)	The feedback wiring is open, shorted, or missing.		• Check motor encoder wiring. • Run Hookup test in RSLogix 5000 software.
E09	**BusUndervoltage Fault** (Bus Undervoltage)	With three-phase power present, the dc bus voltage is below limits.	• DC bus voltage for 460V system is below 275V • DC bus voltage for 230V system is below 137V	• Verify voltage level of the incoming ac power. • Check ac power source for glitches or line drop. • Install an uninterruptible power supply (UPS) on your ac input.
		DC bus voltage fell below the undervoltage limit while an axis on the follower power rail was enabled.		Disable follower axis before removing power.
E10	**DriveOvervoltage Fault** (Bus Overvoltage)	The dc bus voltage is above limits.	Excessive regeneration of power. When the motor is driven by an external mechanical power source, it may regenerate too much peak energy through the drive power supply. The system faults to save itself from an overload.	• Change the deceleration or motion profile. • Use a larger system (motor and Kinetix 6000 drive). • Install shunt module.
			• DC bus voltage for 460V system is over 820V • DC bus voltage for 230V system is over 410V	Verify input is within specifications.
E11	**MotFeedbackFault** (Illegal Hall State)	State of Hall feedback inputs is incorrect.	Bad connections.	• Verify the Hall wiring at the MF connector on the IAM/AM. • Verify 5V power supply to the encoder.

Error Code	Fault Message RSLogix (HIM)	Problem or Symptom	Potential Cause	Possible Resolution
E16	**Softovertravel Fault** (+/- Software Overtravel)	Axis position exceeded maximum software setting.		• Verify motion profile. • Verify overtravel settings are appropriate.
E18	**OverSpeedFault** (Overspeed Fault)	Motor speed has exceeded 150% of maximum rated speed. The 100% trip point is dictated by the lesser of the user velocity limits or the motor rated base speed.		• Check cables for noise. • Check tuning.
E19	**PositionErrorFault** (Follow Error)	Position error limit was exceeded.		• Increase the feed forward gain. • Increase following error limit or time. • Check position loop tuning. • Verify sizing of system. • Verify mechanical integrity of system within specification limits.
E20	**MotFeedbackFault** (Mtr Fdbk AQB)	Motor Encoder State Error	The motor encoder encountered an illegal transition.	• Use shielded cables with twisted pair wires. • Route the feedback away from potential noise sources. • Check the system grounds. • Replace the motor/encoder.
E21	**AuxFeedbackFault** (Aux Feedback Comm)	Communication was not established with an intelligent encoder.		Verify auxiliary encoder wiring.
E30	**MotFeedbackFault** (Motor Feedback Comm)	Communication was not established with an intelligent encoder.		• Verify motor selection. • Verify the motor supports automatic identification. • Verify motor encoder wiring.
E34	**GroundShortFault** (Ground Fault)	Excessive ground current in the converter was detected.	Wiring error.	• Check motor power wiring. • Check input power wiring.
			Motor internal ground short.	Replace motor.
			Internal malfunction.	Disconnect motor power cable from drive and enable drive with current limit set to 0. If fault clears, then a wiring error or motor internal problem exists. If fault remains, call your sales representative.
			Grounded control power terminal (applies to 230V systems only)	• Remove ground from control power input. • Source control power from three-phase input power (refer to page 196). • Add isolation transformer for control power.
E35	**DriveUndervoltage Fault** (Pre-charge Fault)	Converter pre-charge cycle failed.	Low ac input voltage.	Check input ac voltage on all phases.
			Internal malfunction.	Call your sales representative.
E36	**DriveOvertemp Fault** (System Overtemperature)	Converter thermal switch tripped.	Excessive heat exists in the power circuitry.	• Reduce acceleration rates. • Reduce duty cycle (ON/OFF) of commanded motion. • Increase time permitted for motion. • Use larger Kinetix 6000 converter. • Check for clogged vents or defective fan. • Make sure cooling is not restricted by insufficient space around the unit.

Error Code	Fault Message RSLogix (HIM)	Problem or Symptom	Potential Cause	Possible Resolution
E37	**PowerPhaseLoss Fault** (Phase Loss Flt)	• One or more phases of the input ac power is missing. • Axis was enabled when main (three-phase) power was removed. • Common bus follower axis was enabled when dc bus power was removed.		• Check input ac voltage on all phases. • Disable axis before removing power.
E38	**SERCOSFault** (SERCOS Ring Flt)	The SERCOS ring is not active after being active and operational.	Cable disconnected.	Check that fiber-optic cable is present and connected properly.
E39	**DriveHardFault** (Self Sense Flt)	Self-sensing Commutation Startup Error	Motion required for self-sensing startup commutation was obstructed.	• Verify that there are no impediments to motion at startup, such as hard limits. • Increase self-sensing current if high friction or load conditions exist. • Check motor or encoder wiring using wiring diagnostics.
E43	**DriveEnableInput Fault** (Drive Enable Flt)	Missing Drive Enable Input Signal	• An attempt was made to enable the axis through software while the Drive Enable hardware input was inactive. • The Drive Enable input transitioned from active to inactive while the axis was enabled.	• Disable the Drive Enable Input fault. • Verify that Drive Enable hardware input is active whenever the drive is enabled through software.
E49	**DriveHardFault** (Safe-off HW Flt)	Safe-off function mismatch. Drive will not allow motion.	• Loose wiring at SO connector. • Cable/header not seated properly in SO connector. • Safe-off circuit missing +24V dc.	• Verify wire terminations, cable/header connections, and +24V. • Reset error and run proof test. • If error persists, return the drive to Rockwell Automation.
E50	**SERCOSFault** (SERCOS Same ADDR)	Duplicate node address detected on SERCOS ring.		Verify that each SERCOS drive is assigned a unique node address.
E54	**DriveHardFault** (Ifbk HW Fault)	Current feedback hardware fault detected.		Replace the module
E60	**DriveHardFault** (Unknown Axis)	Illegal ID bits detected		Replace the module
E61	**AuxFeedbackFault** (Aux Fdbk AQB)	Auxiliary Encoder State Error	The auxiliary encoder encountered an illegal transition.	• Use shielded cables with twisted pair wires. • Route the feedback away from potential noise sources. • Check the system grounds. • Replace the motor/encoder.
E62	**AuxFeedbackFault** (Aux Fdbk Loss)	The feedback wiring is open, shorted, or missing.		Check the motor feedback cable connectors/wiring to the IAM/AM and motor.
E63	**AuxFeedbackNoise** (Aux Fdbk Noise)	Noise on auxiliary feedback cable.	Recommended grounding, per installation instructions, has not been followed.	• Verify grounding. • Route feedback cable away from noise sources. • Refer to System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001.
E64	**MotorFeedbackNoise** (Mtr Fdbk Noise)	Noise on motor feedback cable.		
E65	**No Fault Message (condition indicated by on-screen message)** (Hookup Fault)	Hookup procedure failed	Motor or feedback device malfunction.	• Check motor power/feedback wiring. • Refer to on-screen message for resolution.

Error Code	Fault Message RSLogix (HIM)	Problem or Symptom	Potential Cause	Possible Resolution
E66	**No Fault Message (condition indicated by on-screen message)** (Atune Flt)	Autotune procedure failed	Motor or feedback device malfunction.	• Check motor power/feedback wiring. • Refer to on-screen message for resolution. • Perform Hookup in RSLogix 5000 software. • Consult RSLogix 5000 help screen.
E67	**DriveHardFault** (Task init)	Operating system failed	Software initialization fault detected due to hardware failure.	• Cycle power. • If fault persists, replace module.
E68	**DriveHardFault** (SCANport Comm)	DPI communication failed	The DPI device or cable is faulty.	Check DPI connections.
E69	**DriveHardFault** (Objects Init)	Non-volatile memory is corrupt due to control board hardware failure.		Load default parameters, save to non-volatile memory, and recycle power or reset the drive.
E70	**DriveHardFault** (NV Mem Init)	Non-volatile memory is corrupt due to control board software error.		Load default parameters, save to non-volatile memory, and recycle power or reset the drive.
E71	**DriveHardFault** (Memory Init)	RAM or Flash memory validation failure		• Cycle power. • If fault persists, replace module.
E72	**DriveOvertemp Fault** (Drive Overtemp)	Inverter thermal switch tripped	The fan on the IAM or an AM failed.	Replace the failed module.
			The cabinet ambient temperature is above rating.	Check the cabinet temperature.
			The machine duty cycle requires an RMS current exceeding the continuous rating of the controller.	Change the command profile to reduce speed or increase time.
			The airflow access to the Kinetix 6000 system is limited or blocked.	Check airflow and re-route cables away from the Kinetix 6000 system.
E73	**Communicate** (Backplane Comm)	Power rail CAN communications failed.		Check module for proper mount.
		Power rail connection shorted or open.		Check power rail and module for foreign objects.
E74	**DriveOvercurrent Fault** (Bus OverCurrent)	DC link current exceeds rating.	Motor or transmission malfunction.	• Check for proper motor sizing. • Check/replace transmission device. • Check/replace motor.
			IAM not properly sized.	• Check for proper IAM sizing. • Install larger kW rated IAM.
E75	**DriveOvervoltage Fault** (Shunt Time Out)	The IAM, AM, or SM has exceeded its shunt resistor continuous rating.		• Use a properly sized shunt or modify duty cycle of the application. • System uses internal shunt and requires external shunt for additional capacity.
E76	**DriveHardFault** (CAN Init)	DPI hardware initialization fault detected.	Control board hardware failure.	• Reset System. • If fault persists, replace system module.
E77	**DriveHardFault** (Module Mismatch)	Either 230V AM is installed on power rail with 460V IAM, or 460V AM is installed on power rail with 230V IAM.		Replace mismatched module.
E78	**DriveHardFault** (SERCOS Init)	Control hardware fault detected.		• Cycle power. • If fault persists, replace module.

Error Code	Fault Message RSLogix (HIM)	Problem or Symptom	Potential Cause	Possible Resolution
E79	**DriveOvervoltage Fault** (Shunt Module Flt)	Shunt module temperature fault LED indicator is steady red.		Refer to Temperature Fault LED Indicator on page 154.
		Shunt module shunt fault LED indicator is steady red.		Refer to Shunt Fault LED Indicator on page 154.
		Module missing from power rail.		• Install missing module on power rail. • Fill empty slot with slot filler module.
E80	**DriveHardFault** (CPLD Flt)	Control hardware fault detected.		Replace module.
E81	**DriveHardFault** (Common Bus Flt)	Follower IAM detected ac input power being applied.		Remove ac input power connections from follower IAM.
E90	**DriveHardFault** (Pre-charge Timeout Flt)	Pre-charge resistor power exceeds the resistor rating.		Allow resistor to cool.
All others	RESERVED			Call your local Rockwell Automation sales representative.

IAM/AM Status Indicators

Drive Status LED Indicator

Drive Status LED Indicator	Status	Potential Cause	Possible Resolution
Off	Normal, no faults	N/A	N/A
Steady Red	Drive faulted	Seven-segment LED displays error code	Refer to seven-segment error code and Error Codes section beginning on page 146.

Comm Status LED Indicator

Comm Status LED Indicator	Status	Potential Cause	Possible Resolution
Steady Green	Communication ready	No faults or failures.	N/A
Flashing Green	Establishing communication	System is still in the process of establishing SERCOS communication.	Wait for steady green LED indicator.
		Node address setting on the drive module does not match SERCOS controller configuration.	Verify proper node switch setting.
Off	No communication (1)	Loose fiber-optic connection.	Verify proper fiber-optic cable connections.
		Broken fiber-optic cable.	Replace fiber-optic cable.
		Receive fiber-optic cable connected to SERCOS transmit connector and vice versa.	Check proper SERCOS fiber-optic cable connections.

(1) Refer to Fiber-optic Cable Installation and Handling Instructions, publication 2090-IN010, for more information.

Bus Status LED Indicator

Bus Status LED Indicator	Status	Condition
Steady Green	Bus power is present, axis enabled. No faults or failures.	Normal when: • 24V is applied to Hardware Enable Input (IOD-2). • MSO instruction is commanded in RSLogix 5000 software.
Flashing Green	Bus power is present, axis disabled. No faults or failures.	Normal when: • 24V is not applied to Hardware Enable Input (IOD-2). • MSO instruction is not commanded in RSLogix 5000 software.
Off	Bus power not present.	• Normal when bus power is not applied. • Fault exists, refer to seven segment error code and Error Codes section beginning on page 146.
	Bus power is present in follower IAM.	• Follower IAM is not configured as CommonBus Follow in RSLogix 5000 software. • After dc bus voltage is applied, a 2.5 second delay before the LED indicator begins flashing green is normal operation to provide common bus leader time to complete pre-charge.

SM Status Indicators

Each of the shunt module LED indicators provide specific troubleshooting information.

General Shunt Module Troubleshooting

Module	Status	Under These Conditions
SM	Fault is latched	Until fault condition is corrected and cleared.
	Fault is cleared	• Using RSLogix MASR, MAFR, MGSR commands or the HIM (red stop button). • Only after the dc bus is discharged (SM Bus Status LED is flashing). • Drive must be configured with 2094-BSP2 or Bulletin 1394 external shunt module.
IAM/AM	Disabled (for dc bus regulation)	• When the 2094-BSP2 shunt module is used on a 230V system. • When either 230V or 460V system is configured with a Bulletin 1394 external shunt module. • When configured in common bus follower mode.
	Enabled to discharge the dc bus	Drive (IAM or leader IAM) three-phase power is removed.
	Disabled from discharging the dc bus	When configured in common bus follower mode.

IMPORTANT Under some fault conditions, two reset commands may be required to clear drive and SM faults.

Bus Status LED Indicator

Bus Status LED	Status	Potential Cause	Possible Resolution
Flashing	Normal condition when control power is applied and bus voltage is less than 60V dc.		N/A
Steady Green	Normal condition when control power is applied and bus voltage is greater than 60V dc.		N/A
Off	Control power is not present	Internal power supply failure	Replace shunt module.

Temperature Fault LED Indicator

Temp Fault LED	Status	Potential Cause	Possible Resolution
Off	Normal condition		N/A
Steady Red	SM internal temperature exceeds operating temperature specification	Shunt module fan failed	Replace shunt module.
		Shunt module temperature exceeds rating	• Allow shunt module to cool. • Reset faults. • Verify IAM bus regulator configuration.
	External over temperature condition	External temperature switch is open	• Allow shunt module to cool. • Reset faults. • Verify IAM bus regulator configuration.
		TS jumper is not present	Install jumper.

Shunt Fault LED Indicator

Shunt Fault LED	Status	Potential Cause	Possible Resolution
Off	Normal condition		N/A
Steady Red	Shorted internal or external shunt resistor	Mis-wired shunt jumper or other short on RC connector	• Correct mis-wire (shorted) condition. • If problem persists, replace shunt module.
		Mis-wired (shorted) external shunt wiring	

All SM Status LED Indicators

SM Status LED	Status	Potential Cause	Possible Resolution
• Bus Status • Temperature Fault • Shunt Fault	All three SM status LED indicators flash simultaneously	Shunt module hardware failure	• Cycle power. • If problem persists, replace shunt module.

Troubleshooting General System Problems

Use the tables below for troubleshooting general system faults.

Condition	Potential Cause	Possible Resolution
Axis or system is unstable.	The position feedback device is incorrect or open.	Check wiring.
	Unintentionally in torque mode.	Check to see what primary operation mode was programmed.
	Motor tuning limits are set too high.	Run Tune in RSLogix 5000 software.
	Position loop gain or position controller accel/decel rate is improperly set.	Run Tune in RSLogix 5000 software.
	Improper grounding or shielding techniques are causing noise to be transmitted into the position feedback or velocity command lines, causing erratic axis movement.	Check wiring and ground.
	Motor Select limit is incorrectly set (servo motor is not matched to axis module).	• Check setups. • Run Tune in RSLogix 5000 software.
	Mechanical resonance	Notch filter or output filter may be required (refer to Axis Properties dialog, Output tab in RSLogix 5000 software).
You cannot obtain the motor acceleration/deceleration that you want.	Torque Limit limits are set too low.	Verify that current limits are set properly.
	Incorrect motor selected in configuration.	Select the correct motor and run Tune in RSLogix 5000 software again.
	The system inertia is excessive.	• Check motor size vs. application need. • Review servo system sizing.
	The system friction torque is excessive.	Check motor size vs. application need.
	Available current is insufficient to supply the correct accel/decel rate.	• Check motor size vs. application need. • Review servo system sizing.
	Acceleration limit is incorrect.	Verify limit settings and correct them, as necessary.
	Velocity Limit limits are incorrect.	Verify limit settings and correct them, as necessary.
Motor does not respond to a velocity command.	The axis cannot be enabled for 1.5 seconds after disabling.	Disable the axis, wait for 1.5 seconds, and enable the axis.
	Enable signal has not been applied or the enable wiring is incorrect.	• Check the controller. • Check the wiring.
	The motor wiring is open.	Check the wiring.
	The motor thermal switch has tripped.	• Check for a fault. • Check the wiring.
	The motor has malfunctioned.	Repair or replace the motor.
	The coupling between motor and machine has broken (i.e., the motor moves, but the load/machine doesn't).	Check and correct the mechanics.
	Primary operation mode is set incorrectly.	Check and properly set the limit.
	Velocity or current limits are set incorrectly.	Check and properly set the limits.

Condition	Potential Cause	Possible Resolution
Presence of noise on command or motor feedback signal wires.	Recommended grounding per installation instructions have not been followed.	• Verify grounding. • Route wire away from noise sources. • Refer to System Design for Control of Electrical Noise, publication GMC-RM001.
	Line frequency may be present.	• Verify grounding. • Route wire away from noise sources.
	Variable frequency may be velocity feedback ripple or a disturbance caused by gear teeth or ballscrew balls etc. The frequency may be a multiple of the motor power transmission components or ballscrew speeds resulting in velocity disturbance.	• Decouple the motor for verification. • Check and improve mechanical performance of the gearbox, ballscrew, etc.
No rotation	The motor connections are loose or open.	Check motor wiring and connections.
	Foreign matter is lodged in the motor.	Remove foreign matter.
	The motor load is excessive.	Verify the servo system sizing.
	The bearings are worn.	Return the motor for repair.
	The motor brake is engaged (if supplied).	• Check brake wiring and function. • Return the motor for repair.
	The motor is not connect to the load.	Check coupling.
Motor overheating	The duty cycle is excessive.	Change the command profile to reduce accel/decel or increase time.
	The rotor is partially demagnetized causing excessive motor current.	Return the motor for repair.
Abnormal noise	Motor tuning limits are set too high.	Run Tune in RSLogix 5000 software again.
	Loose parts are present in the motor.	• Remove the loose parts. • Return motor for repair. • Replace motor.
	Through bolts or coupling is loose.	Tighten bolts.
	The bearings are worn.	Return motor for repair.
	Mechanical resonance	Notch filter may be required (refer to Axis Properties dialog, Output tab in RSLogix 5000 software).
Erratic operation - Motor locks into position, runs without control or with reduced torque.	Motor power phases U and V, U and W, or V and W reversed.	Check and correct motor power wiring.
	Sine, Cosine or Rotor leads are reversed in the feedback cable connector.	Check and correct motor feedback wiring.
	Sine, Cosine, Rotor lead sets of resolver feedback are reversed.	Check and correct motor feedback wiring.

Understanding Logix/Drive Fault Behavior

This section provides the drive fault actions and indicates whether the fault action is programmable.

Drive Fault Action Definitions

Drive Fault Action	Definition
Shutdown	The drive disables and the contactor enable relay opens. Uncontrolled stop, motor coasts to a stop.
Disable Drive	The drive is disabled. Uncontrolled Stop, motor coasts to a stop.
Stop Motion	Logix configuration for velocity loop Kp/Ki is followed. When zero speed is reached or stopping time is exceeded, the drive is disabled. Stopping time and stopping torque are configurable parameters in RSLogix 5000.
Status Only	Drive continues to operate. Status is provided by seven-segment Fault Status LED Indicator, Drive Status LED Indicator, and DPI (if used).

Logix/Drive Fault Behavior

Fault Message RSLogix (HIM)	**Error Code**	**Description**	**Drive Fault Action**	**RSLogix Programmable Fault Action?**
BusUndervoltageFault (Blown fuse)	E00	A blown fuse was detected in the inverter pcb.	SHUTDOWN	N
MotorOvertempFault (Motor Overtemp)	E04	The motor thermal switch was tripped. Firmware I^2t protection does not generate a fault, rather it dynamically folds back current when 110% of motor rating is reached. Setting the Motor Thermal fault action to Status Only will bypass this function.	STOP	Y
DriveOvercurrentFault (Power Fault)	E05	An instantaneous over-current was detected in the inverter power section.	SHUTDOWN	N
HardOvertravelFault (+/- Hard Overtravel)	E06	Axis moved beyond the physical travel limits in the positive/negative direction. This fault can be configured for status only.	STOP	Y
MotFeedbackFault (Motor Feedback Loss)	E07	The feedback wiring is open, shorted or missing.	DISABLE	N
BusUndervoltageFault (Bus Under Voltage)	E09	With 3 phase present, the dc bus voltage is below limits. The trip point is 275V and 137V dc for 460V/230V drives respectively. DC bus voltage is below limits when any axis on common bus follower power rail was enabled.	SHUTDOWN	N
DriveOvervoltageFault (Bus Overvoltage)	E10	The dc bus voltage is above limits. The trip point is 820V and 410V dc for 460V/230V drives respectively.	SHUTDOWN	N
MotFeedbackFault (Illegal Hall State)	E11	State of Hall feedback inputs in incorrect.	DISABLE	N
SoftovertravelFault (+/- Software Overtravel)	E16	Axis position exceeded maximum software setting in the positive/ negative direction. This fault can be configured for status only.	STOP	Y
OverSpeedFault (Overspeed Fault)	E18	Axis speed has reached 150% of the maximum rated setting. The 100% trip point is dictated by the lesser of the user velocity limits or the motor rated base speed.	DISABLE	N
PositionErrorFault (Follow Error)	E19	Axis position error limit has been exceeded. This fault can be configured for status only.	STOP	Y

Fault Message RSLogix (HIM)	**Error Code**	**Description**	**Drive Fault Action**	**RSLogix Programmable Fault Action?**
MotFeedbackFault (Mtr Fdbk AQB)	E20	Motor encoder has encountered an illegal state transition.	DISABLE	N
AuxFeedbackFault (Aux Feedback Comm)	E21	Communication was not established with an intelligent (Stegmann) encoder on the Auxiliary feedback port.	STOP	N
MotFeedbackFault (Motor Feedback Comm)	E30	Communication was not established with an intelligent (Stegmann) encoder on the Motor feedback port.	STOP	N
GroundShortFault (Ground Fault)	E34	Excessive ground current in the converter was detected.	SHUTDOWN	N
DriveUndervoltageFault (Precharge Fault)	E35	The converter pre-charge cycle has failed.	SHUTDOWN	N
DriveOvertempFault (System Overtemperature)	E36	Converter internal temperature limit exceeded.	SHUTDOWN	N
PowerPhaseLossFault (Phase Loss Flt)	E37	• One or more phases of the input AC power is missing. • Axis was enabled when main (three-phase) power was removed. • Common bus follower axis was enabled when dc bus power was removed.	SHUTDOWN/ STOP	N
SERCOSFault (SERCOS Ring Flt)	E38	The SERCOS ring is not active after being active and operational.	STOP	N
DriveHardFault (Self Sense Flt)	E39	Self-sensing commutation fault detected.	DISABLE	N
DriveEnableInputFault (Drive Enable Flt)	E43	Generated when Enable input switches off when drive is enabled.	STOP	Y
DriveHardFault (Safe-Off HW Flt)	E49	Safe-off function mismatch. Drive will not allow motion. Refer to the Kinetix Safe-off Feature Safety Reference Manual, publication GMC-RM002, for more information. Applies to IAM (2094-*x*C*xx*-M*xx*-S) and AM (2094-*x*M*xx*-S) with safe-off feature.	SHUTDOWN	N
SERCOSFault (SERCOS Same ADDR)	E50	Duplicate node address detected on SERCOS ring.	STOP	N
DriveHardFault (Ifbk HW Fault)	E54	Current feedback hardware fault detected.	SHUTDOWN	N
DriveHardFault (Unknown Axis)	E60	Invalid module type identified by firmware when applying power.	SHUTDOWN	N
AuxFeedbackFault (Aux Fdbk AQB)	E61	Auxiliary encoder has encountered an illegal state transition.	DISABLE	N
AuxFeedbackFault (Aux Fdbk Loss)	E62	The feedback wiring is open, shorted or missing.	DISABLE	N
AuxFeedbackNoise (Aux Fdbk Noise)	E63	Presence of noise on auxiliary feedback cable.	DISABLE	Y
MotorFeedbackNoise (Mtr Fdbk Noise)	E64	Presence of noise on motor feedback cable.		
No Fault Message (condition indicated by on-screen message) (Hookup Fault)	E65	Hookup procedure failed.	DISABLE	N

Fault Message RSLogix (HIM)	**Error Code**	**Description**	**Drive Fault Action**	**RSLogix Programmable Fault Action?**
No Fault Message (condition indicated by on-screen message) (Atune Flt)	E66	Autotune procedure failed.	DISABLE	N
DriveHardFault (Task init)	E67	Operating system failed.	SHUTDOWN	N
DriveHardFault (SCANport Comm)	E68	DPI communication failed.	STOP	N
DriveHardFault (Objects Init)	E69	Non-volatile memory attribute out of range.	SHUTDOWN	N
DriveHardFault (NV Mem Init)	E70	Non-volatile memory corrupted.	SHUTDOWN	N
DriveHardFault (Memory Init)	E71	RAM or flash memory validation failure.	SHUTDOWN	N
DriveOvertempFault (Drive Overtemp)	E72	Inverter temperature limit exceeded. Firmware I^2t protection does not generate a fault, rather it dynamically folds back current when 110% of drive rating is reached.	SHUTDOWN	Y
Communicate (Backplane Comm)	E73	Power rail backplane CAN communications failed.	STOP	N
DriveOvercurrentFault (Bus OverCurrent)	E74	The converter has exceeded its converter rating.	SHUTDOWN	N
DriveOvervoltageFault (Shunt Time Out)	E75	The IAM, AM, or SM has exceeded its shunt resistor continuous rating. SHUTDOWN for IAM, DISABLE for AM. IAM also provides fault handling for shunt module.	SHUTDOWN	N
DriveHardFault (Can Init)	E76	Either DPI or backplane CAN initialization failure.	SHUTDOWN	N
DriveHardFault (Module Mismatch)	E77	Generated by IAM if the power rating of an AM on the same power rail does not match with IAM input power rating.	SHUTDOWN	N
DriveHardFault SERCOS Init	E78	Control hardware fault detected.	SHUTDOWN	N
DriveOvervoltageFault (Shunt Module Flt)	E79	Power rail mounted shunt module fault. Displayed on IAM seven-segment fault status LED indicator.	SHUTDOWN	N
HardwareFault (CPLD Flt)	E80	Control hardware fault detected.	SHUTDOWN	N
HardwareFault (Common Bus Flt)	E81	Common bus follower IAM detected ac input power being applied.	SHUTDOWN	N
HardwareFault (Pre-charge Timeout Flt)	E90	Pre-charge resistor power exceeds the resistor rating.	SHUTDOWN	N
RESERVED	All Others			

Supplemental Troubleshooting Information

This section provides information for accessing and changing parameters not accessible through RSLogix 5000 software.

Tools for Changing Parameters

Most parameters are accessible through RSLogix 5000 software. Alternatives include the DPI compatible Human Interface Module (HIM) and DriveExplorer software.

Method	Description	Catalog Number	Firmware Revision
DriveExplorer	DriveExplorer software (1)	9306-4EXP02ENE	2.01 or later
	Serial to SCANport adapter	1203-SSS (Series B)	3.004 or later
HIM	Full numeric LCD HIM	20-HIM-A3 (2)	N/A

(1) Refer to DriveExplorer Getting Results Manual, publication 9306-GR001, for instructions.

(2) Compatible catalog numbers include all 20-HIM-A*x*.

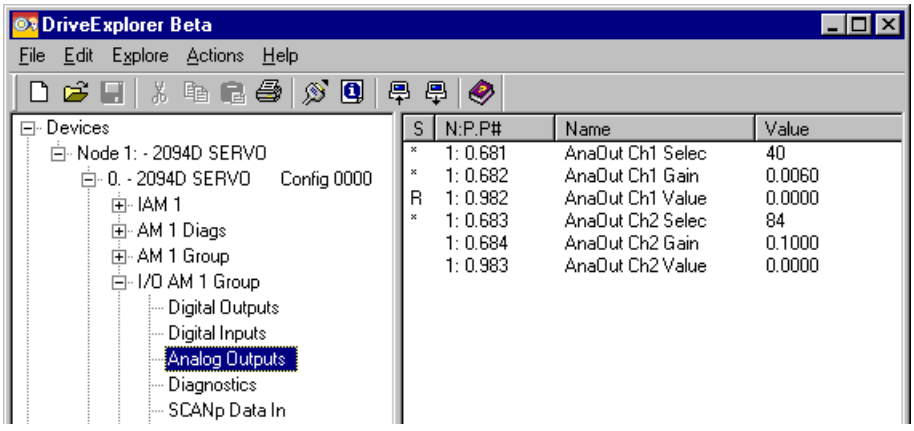
Changing Parameters Using DriveExplorer

To navigate using DriveExplorer, refer to the example dialog below. In this example, the I/O Interface group folder is open, the Analog Outputs parameter is selected, and the parameter elements are displayed in the box to the right.

IMPORTANT Parameters are read-only when the SERCOS ring is active. You must break the SERCOS ring to change parameters.

To save changes, perform a non-volatile save (NVS) prior to cycling power.

DriveExplorer Example



Changing Parameters Using the HIM

When using the HIM to monitor or change parameters, use the up and down arrows (∧ and ∨) to arrive at selections. Refer to the instructions that came with your HIM for more information.

Follow these steps to monitor or change parameters using the HIM.

1. Select parameter. Press ↵.
2. Select I/O AM1 Group (for IAM). Press ↵.
3. Select Analog Outputs. Press ↵.
   a. Analog Output 1 is displayed. Press ↵.
   b. For Analog Output 2 use arrows to select. Press ↵.
4. Press Sel.
5. Enter parameter number. Press ↵.

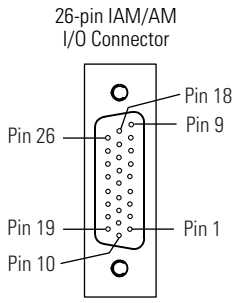
Using Analog Test Points to Monitor System Variables

There are two analog output test points accessible from the IOD 26-pin connector on the IAM and AM.

IAM/AM I/O 26-pin (IOD) Connector

IOD Pin	Description	Signal
23	Analog output 0	DAC0
24	Analog output common	DAC_COM
25	Analog output 1	DAC1
26	Analog output common	DAC_COM

Pin Orientation for 26-pin I/O (IOD) Connector



Refer to Analog Outputs on page 62 for signal specifications.

Parameters begin with a variable to identify a specific axis by slot number, as follows:

- IAM = 0 for parameters 0...999
- 1st AM = 1 for parameters 1000...1999
- 2nd AM = 2 for parameters 2000...2999 and so on...
- 7th AM = 7 for parameter 7000...7999

Monitor System Variables

Analog Output	Controlling Parameter		Scale Parameter	
	Parameter Number (1)	Default Value (1)	Parameter Number (1)	Default Value
1	*x*681	*xx*40	*x*682	0.0060
2	*x*683	*xx*84	*x*684	0.1000

(1) *x* = slot number

The value entered in Scale Parameter will scale the analog output so that you can get a full scale reading of the specific parameter for the dynamic range or values you are testing.

Monitor Dynamic System Variables

Attribute	Parameter Number (1)
Velocity feedback (2)	*xx*40
Velocity commanded (2)	*xx*36
Torque feedback (3))	*xx*84
Torque commanded (3)	*xx*80
Following error (4))	*x*189

(1) *x* = slot number.

(2) Velocity Command and Feedback scaling value is 0.25V = 1000 rpm (using default scaling).

(3) Torque Command and Feedback scaling value is 0.25V = 100% rated motor current or amplifier rating (whichever is less) using default scaling.

(4) Output scaling is dependant on feedback device and drive resolution.

Removing and Replacing the Kinetix 6000 Drive Modules

Introduction

This chapter provides remove and replace procedures for your Kinetix 6000 system components.

ATTENTION

This drive contains ESD (Electrostatic Discharge) sensitive parts and assemblies. You are required to follow static control precautions when you install, test, service, or repair this assembly. If you do not follow ESD control procedures, components can be damaged. If you are not familiar with static control procedures, refer to Allen-Bradley publication 8000-4.5.2, Guarding Against Electrostatic Damage or any other applicable ESD Protection Handbook.

Before You Begin

You will need the following tools available before you begin removal and replacement procedures:

- A flat blade screw driver
- A small flat blade screw driver, 3.5 mm (0.14 in.)
- Voltmeter

Removing Power Rail Modules

Follow these steps to remove modules from the power rail.

1. Verify that all control and input power has been removed from the system.

ATTENTION

To avoid shock hazard or personal injury, assure that all power has been removed before proceeding. This system may have multiple sources of power. More than one disconnect switch may be required to de-energize the system.

2. Allow five minutes for the dc bus to completely discharge before proceeding.

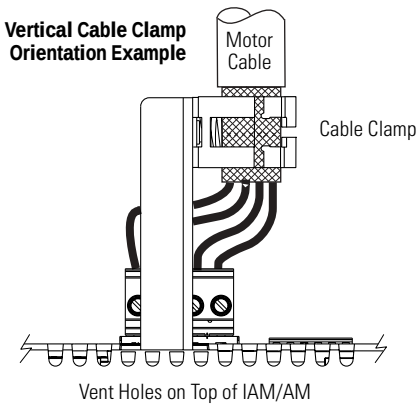
ATTENTION

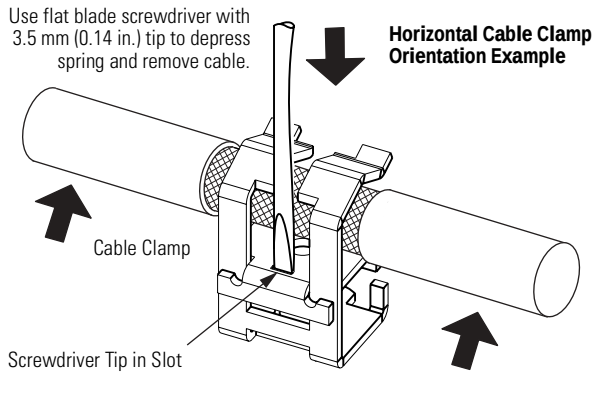
This product contains stored energy devices. To avoid hazard of electrical shock, verify that all voltage on capacitors has been discharged before attempting to service, repair, or remove this unit. You should only attempt the procedures in this document if you are qualified to do so and are familiar with solid-state control equipment and the safety procedures in publication NFPA 70E.

3. Label and remove all connectors from the module (IAM, AM, or SM) you are removing.

   To identify each connector, refer to page 50 (IAM/AM) or page 68 (SM). The slot filler module has no connectors aside from the connections to the power rail.

4. Remove the motor cable from the cable shield clamp, as shown in the examples below.

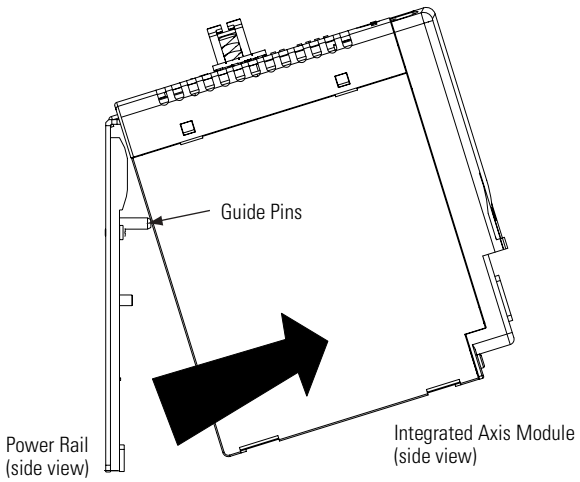




5. Loosen the mounting screw (bottom center of each module).

6. Grasp top and bottom of the module with both hands and gently pull the module away from the connectors enough to clear the guide pins (module will pivot on top bracket).

7. Lift the bracket out of the power rail slot and remove module from the power rail.



Replacing Power Rail Modules

Follow these steps to replace the power rail modules.

1. Determine your power rail replacement.

If you are	Then
Replacing a power rail module on the existing power rail	Go to Step 3.
Replacing a power rail module on a new power rail	Go to Step 2.

2. Prepare to mount your replacement module by removing the protective boots from the power rail connector.

3. Hang the mounting bracket from the slot on the power rail.

IMPORTANT Power rail must be in vertical orientation before replacing modules or pins may not seat properly.

4. Align the guide pins on the power rail with the guide pin holes in the back of the module (refer to the figure above).

TIP The IAM can have two or three power rail connectors and guide pins, the AM can have one or two, all other modules have only one connector and one guide pin.

5. Use 2.26 Nm (20 lb-in) torque to tighten the mounting screw.

6. Re-connect the module connectors.

7. Re-apply power to the system.

8. Verify that the system is operating properly.

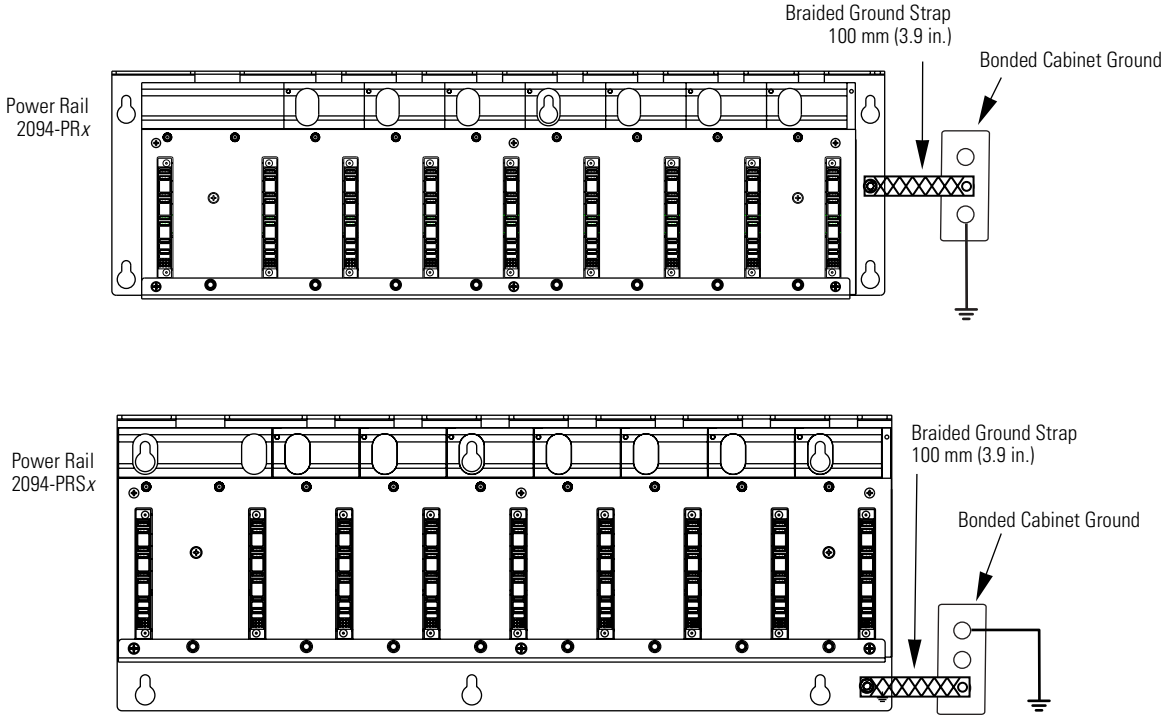
TIP Because IAM and AM parameters reside in the RSLogix 5000 software, you do not need to perform any tuning or setup procedures.

Removing the Power Rail

This procedure assumes you have removed all modules from the power rail.

Follow these steps to remove the power rail.

1. Disconnect the braided grounding strap from the grounding stud located on the right side of the power rail.



2. Loosen the mounting bolts (removing the bolts is not necessary).

3. Lift the power rail up and off of the mounting bolts.

Replacing the Power Rail

This procedure assumes you do not need to change the location of the power rail on the panel and you intend to reuse the mounting bolts of the power rail you just removed.

IMPORTANT If you need to change the location of the power rail, or if you are installing a power rail designed for additional or fewer modules than you removed, refer to Kinetix 6000 Power Rail Installation Instructions, publication 2094-IN003.

ATTENTION To avoid damage to the power rail during installation, do not remove the protective boots until the module for each slot is ready for mounting.

Follow these steps to replace the power rail.

1. Align the replacement power rail over the existing mounting bolts.

   IMPORTANT To improve the bond between the power rail and subpanel, construct your subpanel out of zinc plated (paint-free) steel.

2. Tighten the mounting bolts.

3. Re-attach the braided grounding strap to the power rail grounding stud (refer to page 166).

Specifications and Dimensions

Introduction

This appendix provides product specifications and mounting dimensions for your Kinetix 6000 system components.

Power Specifications

This section contains power specifications for your Kinetix 6000 system components.

Integrated Axis Module (converter) Power Specifications

IAM (230V) Power Specifications

Specification	Description				
	2094-AC05-MP5-S	2094-AC05-M01-S	2094-AC09-M02-S	2094-AC16-M03-S	2094-AC32-M05-S
AC input voltage	195...264V rms three-phase (230V nom)				
AC input frequency	47...63 Hz				
Main ac input current [1] Nom (rms) Max inrush (0-pk)	 10 A 20 A		 19 A 33 A	 36 A 65 A	 71 A 120 A
DC input voltage (common bus follower)	275...375V dc				
DC input current (common bus follower)	10 A		19 A	36 A	71 A
Control power ac input voltage	95...264V rms single-phase (230V nom)				
Control power ac input current Nom (@ 220/230V ac) rms Nom (@ 110/115V ac) rms Max inrush (0-pk)	 3 A 6 A 20 A			 3 A 6 A 83 A [2]	
Nominal bus output voltage	325V dc				
Line loss ride through	20 ms				
Continuous output current to bus (A_{dc})	10 A		19 A	36 A	71 A
Intermittent output current to bus (A_{dc}) [3]	20 A		38 A	72 A	142 A
Bus overvoltage	425V dc				
Bus undervoltage	138V dc				
Internal shunt Continuous power Peak power	 N/A N/A		 50 W 8000 W	 200 W 5600 W	 200 W 5600 W
Internal shunt resistor	N/A		20 Ω	28.75 Ω	28.75 Ω
Shunt on	N/A		405V dc		
Shunt off	N/A		375V dc		
Continuous power output to bus	3 kW		6 kW	11.3 kW	22.5 kW
Peak power output	6 kW		12 kW	22.6 kW	45.0 kW
Efficiency	95%				
Converter inductance	N/A			150 µH	75 µH
Converter capacitance	270 µF		540 µF	1320 µF	1980 µF

(1) All 2094-*x*C*xx* integrated axis modules are limited to 2 contactor cycles per minute (with up to 4 axis modules), or 1 contactor cycle per minute (with 5 to 8 axis modules).

(2) Maximum inrush duration is less than 1/2 line cycle.

(3) Intermittent output current duration equals 250 ms.

IAM (460V) Power Specifications

Specification	Description				
	2094-BC01-MP5-S	2094-BC01-M01-S	2094-BC02-M02-S	2094-BC04-M03-S	2094-BC07-M05-S
AC input voltage	324...528V rms three-phase (360...480V nom)				
AC input frequency	47...63 Hz				
Main ac input current [1] Nom (rms) Max inrush (0-pk)	 10 A 10 A		 24 A 20 A	 44 A 34 A	 71 A 56 A
DC input voltage (common bus follower)	458...747V dc				
DC input current (common bus follower)	10 A		24 A	43 A	71 A
Control power ac input voltage	95...264V rms single-phase (230V nom)				
Control power ac input current Nom (@ 220/230V ac) rms Nom (@ 110/115V ac) rms Max inrush (0-pk)	 3 A 6 A 25 A				
Nominal bus output voltage	650V dc				
Line loss ride through	20 ms				
Continuous output current to bus (A_{dc})	10 A		24 A	43 A	71 A
Intermittent output current to bus (A_{dc}) [2]	20 A		48 A	86 A	142 A
Bus overvoltage	825V dc				
Bus undervoltage	275V dc				
Internal shunt Continuous power Peak power	 50 W 5600 W			 200 W 22,300 W	
Internal shunt resistor	115 Ω			28.75 Ω	
Shunt on	805V dc				
Shunt off	755V dc				
Continuous power output to bus	6 kW		15 kW	27.6 kW	45 kW
Peak power output	12 kW		30 kW	55.2 kW	90 kW
Efficiency	95%				
Converter inductance	250 µH			125 µH	75 µH
Converter capacitance	110 µF		220 µF	940 µF	1410 µF

(1) All 2094-*xCxx* integrated axis modules are limited to 2 contactor cycles per minute (with up to 4 axis modules), or 1 contactor cycle per minute (with 5 to 8 axis modules).

(2) Intermittent output current duration equals 250 ms.

Axis Module (inverter) Power Specifications

The following tables list power specifications for the Kinetix 6000 axis modules. The specifications apply to the axis module specified in the column heading by catalog number and the same axis module (inverter section) that resides within an integrated axis module.

AM (inverter) 230V Power Specifications

Specification	Description				
	2094-AMP5-S (2094-AC05-MP5-S)	**2094-AM01-S (2094-AC05-M01-S)**	**2094-AM02-S (2094-AC09-M02-S)**	**2094-AM03-S (2094-AC16-M03-S)**	**2094-AM05-S (2094-AC32-M05-S)**
Bandwidth [1] Velocity loop Current loop	 500 Hz 1300 Hz				
PWM frequency	8 kHz		4 kHz		
Nominal input voltage	325V dc				
Continuous current (rms)	3.7 A	6.0 A	10.6 A	17.3 A	34.6 A
Continuous current (0-pk)	5.2 A	8.5 A	15.0 A	24.5 A	48.9 A
Peak current (rms) [2]	7.4 A	12.0 A	21.2 A	34.6 A	51.9 A
Peak current (0-pk) [2]	10.5 A	17.0 A	30.0 A	48.9 A	73.4 A
Continuous power out (nom)	1.2 kW	1.9 kW	3.4 kW	5.5 kW	11.0 kW
Internal shunt Continuous power Peak power	 N/A N/A			 50 W 1400 W	
Internal shunt resistor	N/A			115 Ω	
Shunt on	N/A			405V dc	
Shunt off	N/A			375V dc	
Efficiency	98%				
Capacitance	390 µF	660 µF	780 µF	1320 µF	2640 µF
Capacitive energy absorption	15 J	25 J	29 J	50 J	99 J

(1) Bandwidth values vary based on tuning parameters and mechanical components.

(2) Peak current duration equals 2.5 seconds.

AM (inverter) 460V Power Specifications

Specification	Description				
	2094-BMP5-S (2094-BC01-MP5-S)	2094-BM01-S (2094-BC01-M01-S)	2094-BM02-S (2094-BC02-M02-S)	2094-BM03-S (2094-BC04-M03-S)	2094-BM05-S (2094-BC07-M05-S)
Bandwidth [1] Velocity loop Current loop	 500 Hz 1300 Hz				
PWM frequency	8 kHz		4 kHz		
Nominal input voltage	650V dc				
Continuous current (rms)	2.8 A	6.1 A	10.3 A	21.2 A	34.6 A
Continuous current (sine) 0-pk	4.0 A	8.6 A	14.6 A	30.0 A	48.9 A
Peak current (rms) [2]	4.2 A	9.2 A	15.5 A	31.8 A	51.9 A
Peak current (0-pk) [2]	5.9 A	12.9 A	21.8 A	45.0 A	73.4 A
Continuous power out (nom)	1.8 kW	3.9 kW	6.6 kW	13.5 kW	22.0 kW
Internal shunt Continuous power Peak power	 50 W 5600 W			 200 W 22,300 W	
Internal shunt resistor	115 Ω			28.75 Ω	
Shunt on	805V dc				
Shunt off	755V dc				
Efficiency	97%				
Capacitance	75 µF	150 µF	270 µF	840 µF	1175 µF
Capacitive energy absorption	10 J	19 J	35 J	108 J	152 J

(1) Bandwidth values vary based on tuning parameters and mechanical components.

(2) Peak current duration equals 2.5 seconds.

Shunt Module Power Specifications

2094 (rail-mounted) Shunt Module Specifications

Kinetix 6000 Drives	Shunt Module Catalog Number	Specifications					Fuse Replacement
		Drive Voltage V ac	Resistance Ω	Peak Power kW	Peak Current A	Continuous Power W	
2094-AC*xx*-M*xx*-S or 2094-BC*xx*-M*xx*-S	2094-BSP2	230	28.75	5.7	14	200	N/A (no internal fuse)
		460		22.5	28		

For External Shunt Module Specifications, refer to page 184.

In the table below, the 230V system specifications are given for the IAM internal shunt resistors, the Kinetix 6000 (2094-BSP2) SM, and the Bulletin 1394 passive external shunt modules.

Shunt Module (230V) System Specifications

Kinetix 6000 (230V) IAM 2094-	Number of Axis Modules Quantity	Shunt Module Specifications					External Passive Shunt Module [1]	System Continuous Shunt Power W
		Catalog Number	Resistance Ω	Peak Current A	Peak Power kW	Continuous Power W		
AC05-MP5-S	0 to 7	N/A [2]	–	–	–	–	N/A [2]	0
AC05-M01-S			–	–	–	–		0
AC09-M02-S			–	–	–	–		50 [3]
AC16-M03-S			–	–	–	–		200 plus [4]
AC32-M05-S			–	–	–	–		
AC*xx*-M*xx*-S	0 to 6	2094-BSP2	28.75	14.1	5.7	200	N/A [2]	200 plus [5]
AC*xx*-M*xx*-S	0 to 6	2094-BSP2	4	101.3	41	300	1394-SR9A	300 [6]
AC*xx*-M*xx*-S						900	1394-SR9AF	900 [6]
AC*xx*-M*xx*-S						1800	1394-SR36A	1800 [6]
AC*xx*-M*xx*-S						3600	1394-SR36AF	3600 [6]

(1) Refer to page 184 for external shunt module specifications.

(2) Module not part of system configuration.

(3) 50 or the sum of the AM internal shunt ratings.

(4) 200 plus the sum of the AM internal shunt ratings.

(5) 200 plus the sum of the IAM (2094-AC16-M03 and -AC32-M05 only) and AM internal shunt ratings.

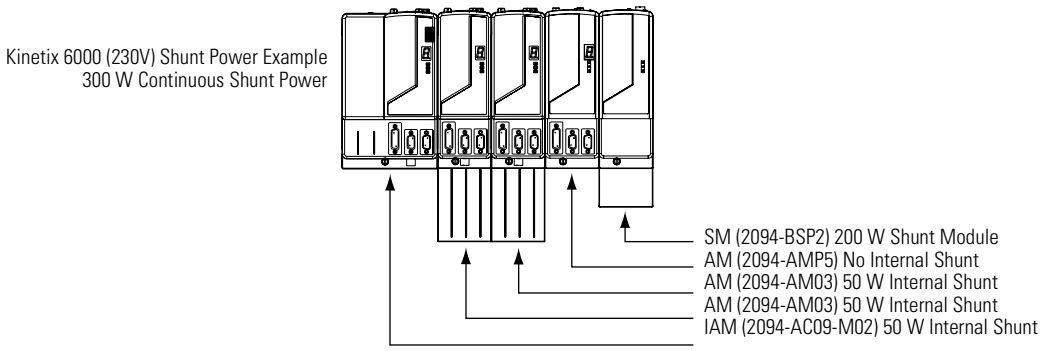
(6) Use of external shunt disables shunts internal to IAM and AM.

IMPORTANT The Kinetix 6000 shunt module, catalog number 2094-BSP2, used in combination with the 2094-AC09-M02 IAM, disables the shunt resistor internal to that IAM. This situation is unique to the 2094-AC09-M02 IAM. Shunt resistors internal to adjacent AMs are not disabled.

Refer to the 2094-AC09-M02 example on page 175.

In the example below, the continuous shunt power is 300 W. The 50 W resistor in the IAM is disabled when used in combination with the (2094-BSP2) SM. This example is unique to the 2094-AC09-M02 IAM.

230V Shunt Power Example (2094-AC09-M02)



In the table below, the 460V system specifications are given for the IAM internal shunt resistors, the Kinetix 6000 (2094-BSP2) SM, and the Bulletin 1394 passive external shunt modules.

Shunt Module (460V) System Specifications

Kinetix 6000 (460V) IAM 2094-	Number of Axis Modules Quantity	Shunt Module Specifications					External Passive Shunt Module (1)	System Continuous Shunt Power W
		Catalog Number	Resistance Ω	Peak Current A	Peak Power kW	Continuous Power W		
BC01-MP5-S	0 to 7	N/A (2)	–	–	–	–	N/A (2)	50 plus (3)
BC01-M01-S			–	–	–	–		50 plus (3)
BC02-M02-S			–	–	–	–		50 plus (3)
BC04-M03-S			–	–	–	–		200 plus (4)
BC07-M05-S			–	–	–	–		
BC*xx*-M*xx*-S	1 to 6	2094-BSP2	28.75	28	22.5	200	N/A (2)	200 plus (5)
BC*xx*-M*xx*-S	1 to 6	2094-BSP2	4	201.3	162	300	1394-SR9A	300 (6)
BC*xx*-M*xx*-S						900	1394-SR9AF	900 (6)
BC*xx*-M*xx*-S						1800	1394-SR36A	1800 (6)
BC*xx*-M*xx*-S						3600	1394-SR36AF	3600 (6)

(1) Refer to page 184 for external shunt module specifications.

(2) Module not part of system configuration.

(3) 50 plus the sum of the AM internal shunt ratings.

(4) 200 plus the sum of the AM internal shunt ratings.

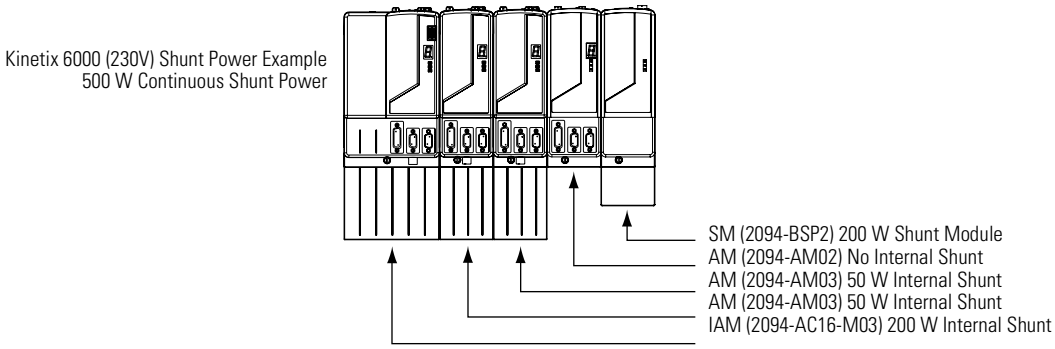
(5) 200 plus the sum of the IAM and AM internal shunt ratings.

(6) Use of external shunt disables shunts internal to IAM and AM.

In the example below, the sum of the IAM, AMs, and SM equal 500 W of continuous shunt power.

TIP Shunt power adds up the same way for 460V (IAM, AM, and SM) systems too.

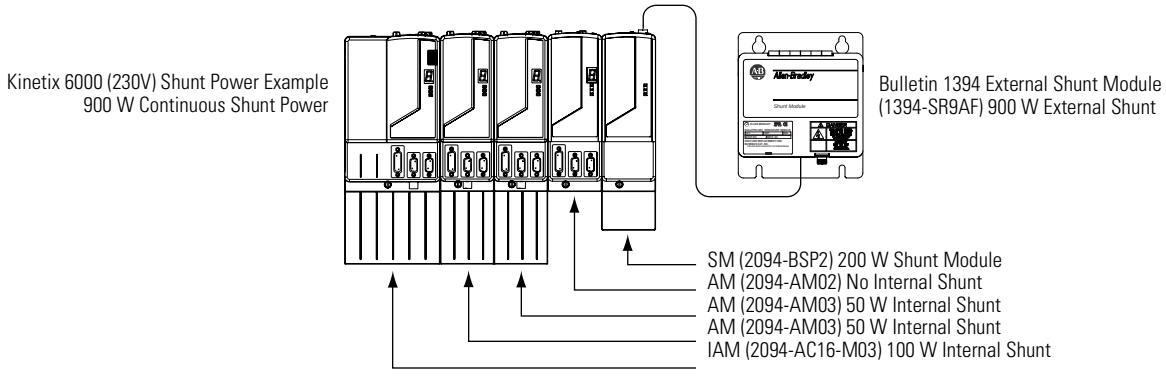
Shunt Power Example (without external shunt)



In the example below, the system is identical to that shown in the example above, except the Kinetix 6000 (2094-BSP2) shunt module is wired to a Bulletin 1394 external shunt module. The IAM and AM internal shunt power is disabled and the continuous shunt power is equal to that of the external shunt module alone.

TIP The external shunt disables the internal shunt capacity of 460V (IAM, AM, and SM) systems too.

Shunt Power Example (with external shunt)



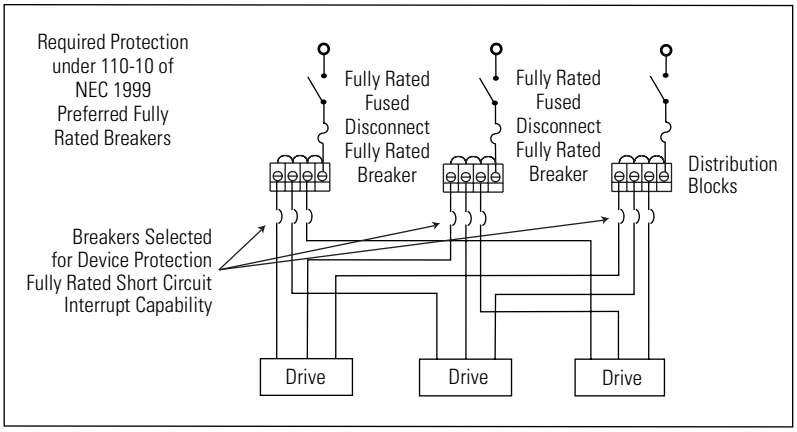
Circuit Breaker/Fuse Specifications

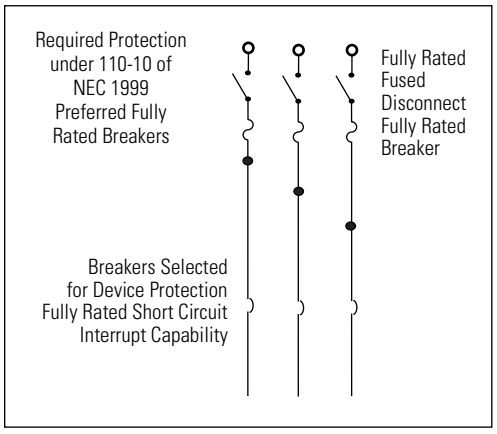
While circuit breakers offer some convenience, there are limitations for their use. Circuit breakers do not handle high current inrush as well as fuses. The Kinetix 6000 needs to be protected by a device having a short circuit interrupt current rating of the service capacity provided or a maximum of 100,000 A.

If an upstream circuit protection device is rated for the overload current and short circuit rating, a supplementary circuit protection device (such as the 1492 product) can be used as the only Kinetix 6000 branch circuit protection device. The upstream fully rated device let-through must be less than or equal to the 10 kA interrupt rating of the 1492 circuit protection device.

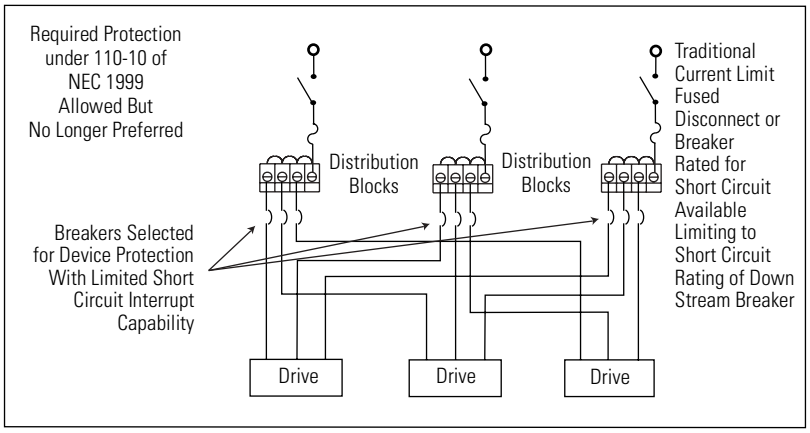
The wiring interconnection in the figures below provide examples of the needed protection and follows UL and NEC codes. Full compliance is dependent on final wiring design and installation.

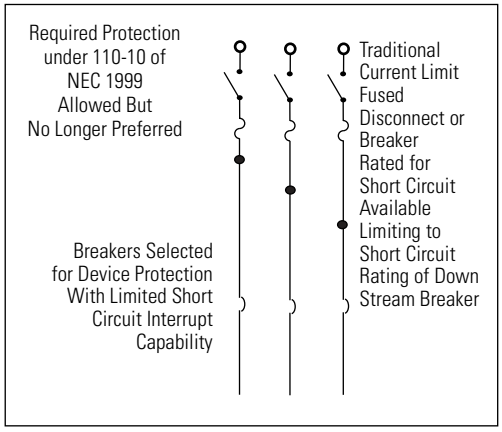
Circuit Protection under NEC 1999 110-10 (preferred fully rated devices)





Circuit Protection under NEC 1999 110-10 (allowed but no longer preferred)





Use class CC, J, L, or R fuses, with current rating as indicated in the table below. The following fuse examples and Allen-Bradley circuit breakers are recommended for use with integrated axis modules (2094-*x*C*xx*-M*xx*-S) when the Line Interface Module (LIM) is not used.

IMPORTANT Line Interface Modules (2094-AL*xx*S, -BL*xx*S, and -XL75S-C*x*) provide branch circuit protection to the IAM. Follow all applicable NEC and local codes.

Fuse Specifications

Catalog Number	V ac Input Power			Control Input Power		DC Common Bus Fuse	
	Bussmann Fuse	Allen-Bradley Circuit Breaker (1)		Bussmann Fuse	Allen-Bradley Circuit Breaker (1)	Bussmann Fuse	Ferraz Shawmut Fuse
2094-AC05-MP5-S	KTK-R-20 (20 A)	1492-CB3H300	140M-F8E-C16	FNQ-R-10 (10 A)	1492-CB2H060	N/A	A50P20-1
2094-AC05-M01-S							
2094-AC09-M02-S	KTK-R-30 (30 A)	1492-CB3H400	140M-F8E-C20			FWH-35B	A50P35-4
2094-AC16-M03-S	LPJ-45SP (45 A)	N/A	140U-H6C3-C50		1492-SP2D200	FWH-60B	A50P60-4
2094-AC32-M05-S	LPJ-80SP (80 A)	N/A	140U-H6C3-C90			FWH-125B	A50P125-4
2094-BC01-MP5-S	KTK-R-20 (20 A)	1492-CB3H300	140M-F8E-C32		1492-CB2H060	N/A	A100P20-1
2094-BC01-M01-S							
2094-BC02-M02-S	KTK-R-30 (30 A)	1492-CB3H400	140M-F8E-C45			FWJ-40A	A100P40-1
2094-BC04-M03-S	LPJ-45SP (45 A)	N/A	140U-H6C3-C50			FWJ-70A	A100P70-1
2094-BC07-M05-S	LPJ-80SP (80 A)		140U-H6C3-C90			FWJ-125A	A100P125-1

(1) When using Bulletin 1492 circuit protection devices, the maximum short circuit current available from the source is limited to 5000 A.

ATTENTION Bulletin 1492 and 140M circuit breakers should not be used on the output of an ac drive as an isolating disconnect switch or motor overload device. These devices are designed to operate on sine wave voltage and the drive's PWM waveform does not allow it to operate properly. As a result, damage to the device will occur.

Contactor Ratings

The table below lists the recommended contactor ratings for integrated axis modules installed without a line interface module.

Catalog Number 230V IAM	Contactor
2094-AC05-MP5-S	100-C23x10 (ac coil) 100-C23Zx10 (dc coil)
2094-AC05-M01-S	
2094-AC09-M02-S	100-C37x10 (ac coil) 100-C37Zx10 (dc coil)
2094-AC16-M03-S	100-C72x10 (ac coil) 100-C72Zx10 (dc coil)
2094-AC32-M05-S	100-C85x10 (ac coil) 100-C85Zx10 (dc coil)

Catalog Number 460V IAM	Contactor
2094-BC01-MP5-S	100-C23x10 (ac coil) 100-C23Zx10 (dc coil)
2094-BC01-M01-S	
2094-BC02-M02-S	100-C37x10 (ac coil) 100-C37Zx10 (dc coil)
2094-BC04-M03-S	100-C60x10 (ac coil) 100-C60Zx10 (dc coil)
2094-BC07-M05-S	100-C72x10 (ac coil) 100-C72Zx10 (dc coil)

Transformer Specifications for Control Power Input

Attribute	Value (460V system)
Input volt-amperes	750VA
Input voltage	460V ac
Output voltage	120...240V ac

Power Dissipation Specifications

Use the following table to size an enclosure and calculate required ventilation for your Kinetix 6000 drive system.

Kinetix 6000 Modules	Usage as % of Rated Power Output (watts)				
	20%	40%	60%	80%	100%
Integrated axis module (IAM converter) [1]					
2094-AC05-MP5-S	19	23	27	31	35
2094-AC05-M01-S					
2094-AC09-M02-S	33	51	69	87	105
2094-AC16-M03-S	18	38	60	83	108
2094-AC32-M05-S	31	64	102	144	190
2094-BC01-MP5-S	15	20	25	30	35
2094-BC01-M01-S					
2094-BC02-M02-S	20	30	40	50	60
2094-BC04-M03-S	22	43	65	86	108
2094-BC07-M05-S	44	77	111	144	177
Integrated axis module (IAM Inverter) or axis module (AM) [1]					
2094-AC05-MP5-S or -AMP5-S	60	65	70	75	80
2094-AC05-M01-S or -AM01-S	62	69	76	83	90
2094-AC09-M02-S or -AM02-S	64	73	82	91	100
2094-AC16-M03-S or -AM03-S	50	72	99	130	165
2094-AC32-M05-S or -AM05-S	106	160	220	285	356
2094-BC01-MP5-S or -BMP5-S	75.7	80.9	86	92	98
2094-BC01-M01-S or -BM01-S	95	120	145	170	195
2094-BC02-M02-S or -BM02-S	98	126	154	182	210
2094-BC04-M03-S or -BM03-S	95	132	171	212	256
2094-BC07-M05-S or -BM05-S	118	182	251	326	406
Shunt module (SM)					
2094-BSP2	68	121	174	227	280

[1] Internal shunt power is not included in the calculations and must be added based on utilization.

General Specifications

This section contains general specifications for your Kinetix 6000 system components.

Maximum Feedback Cable Lengths

Although motor feedback cables are available in standard lengths up to 90 m (295.3 ft), the drive/motor/feedback combination may limit the maximum cable length, as shown in the tables below. These tables assume the use of recommended 2090 series cables.

MP-Series (MPL and MPG) Motors

MPL-A (230V) Motors		MPL-B (460V) Motors			MPG-A (230V) Motors	MPG-B (460V) Motors
Absolute High-resolution [1] m (ft)	Incremental [2] m (ft)	Absolute High-resolution [1] m (ft)	Incremental [2] m (ft)	Resolver [3] m (ft)	Absolute High-resolution [4] m (ft)	Absolute High-resolution [4] m (ft)
30 (98.4)	30 (98.4)	90 (295.3)	30 (98.4)	90 (295.3)	30 (98.4)	60 (196.8)

(1) Refers to MPL-A/B*xxx*S/M (single-turn or multi-turn) low inertia motors with absolute high-resolution feedback.
(2) Refers to MPL-A/B*xxx*H low inertia motors with 2000-line incremental feedback.
(3) Refers to MPL-A/B*xxx*R low inertia motors with 2-pole resolver feedback.
(4) Refers to MPG-A/B*xxx*S/M (single-turn or multi-turn) integrated gear motors with absolute high-resolution feedback.

MP-Series (MPF and MPS), 1326AB, and TL-, F-, and Y-Series Motors

MPF-A and MPS-A (230V) Motors	MPF-B and MPS-B (460V) Motors	1326AB (M2L/S2L) (460V) Motors	1326AB (460V) Motors	F- and Y-Series (230V) Motors	TL-Series (230V) Motors
Absolute High-resolution [1] [2] m (ft)	Absolute High-resolution [1] [2] m (ft)	Absolute High-resolution [3] m (ft)	Resolver [4] m (ft)	Incremental [5] m (ft)	Incremental [6] m (ft)
30 (98.4)	90 (295.3)	90 (295.3)	90 (295.3)	30 (98.4)	30 (98.4)

(1) Refers to MPF-A/B*xxxx*S/M (single-turn or multi-turn) food grade motors with absolute high-resolution feedback.
(2) Refers to MPS-A/B*xxxx*S/M (single-turn or multi-turn) stainless steel motors with absolute high-resolution feedback.
(3) Refers to 1326AB-B*xxxx*-M2L/S2L (single-turn or multi-turn) motors with absolute high-resolution feedback.
(4) Refers to 1326AB-B*xxxx*-21 motors with resolver feedback.
(5) Refers to F- and Y-Series motors with incremental (optical encoder) feedback.
(6) Refers to TL-A*xxxx*-H low inertia motors with incremental feedback.

Environmental Specifications

Specification	Operational Range	Storage Range (non-operating)
Ambient Temperature	0…50 ° C (32…122 ° F)	-40…70 ° C (-40…158 ° F)
Relative Humidity	5…95% noncondensing	5…95% noncondensing
Altitude	1000 m (3281 ft)	3000 m (9843 ft) during transport
Vibration	5…55 Hz @ 0.35 mm (0.014 in.) double amplitude, continuous displacement; 55…500 Hz @ 2.0 g peak constant acceleration	
Shock	15 g, 11 ms half-sine pulse (3 pulses in each direction of 3 mutually perpendicular directions)	

Weight Specifications

Kinetix 6000 Module	Catalog Number	Value, Approx. kg (lb)
IAM (230V)	2094-AC05-MP5-S	2.23 (4.9)
	2094-AC05-M01-S	2.27 (5.0)
	2094-AC09-M02-S	2.31 (5.1)
	2094-AC16-M03-S	4.71 (10.4)
	2094-AC32-M05-S	7.43 (16.4)
AM (230V)	2094-AMP5-S	1.46 (3.2)
	2094-AM01-S	1.50 (3.3)
	2094-AM02-S	1.54 (3.4)
	2094-AM03-S	3.13 (6.9)
	2094-AM05-S	3.18 (7.0)
Power Rails (Slim)	2094-PRS1	1.05 (2.3)
	2094-PRS2	1.59 (3.5)
	2094-PRS3	2.14 (4.7)
	2094-PRS4	2.67 (5.9)
	2094-PRS5	3.11 (6.8)
	2094-PRS6	3.55 (7.8)
	2094-PRS7	3.99 (8.8)
	2094-PRS8	4.43 (9.7)

Kinetix 6000 Module	Catalog Number	Value, Approx. kg (lb)
IAM (460V)	2094-BC01-MP5-S	4.98 (11.0)
	2094-BC01-M01-S	5.03 (11.1)
	2094-BC02-M02-S	5.08 (11.2)
	2094-BC04-M03-S	9.60 (21.1)
	2094-BC07-M05-S	10.1 (22.3)
AM (460V)	2094-BMP5-S	2.44 (5.4)
	2094-BM01-S	2.49 (5.5)
	2094-BM02-S	2.54 (5.6)
	2094-BM03-S	4.58 (10.1)
	2094-BM05-S	4.98 (11.0)
Power Rails	2094-PR1	1.04 (2.3)
	2094-PR2	1.41 (3.1)
	2094-PR4	2.18 (4.8)
	2094-PR6	2.90 (6.4)
	2094-PR8	3.63 (8.0)
SM (460V)	2094-BSP2	3.10 (6.8)
Slot Filler Module	2094-PRF	0.45 (1.0)

Certifications

Certification [1] (when product is marked)	Standards
c-UL-us	UL Listed to U.S. and Canadian safety standards (UL 508 C File E59272).
CE	European Union 89/336/EEC EMC Directive compliant with EN 61800-3:2004: Adjustable Speed Electrical Power Drive Systems - Part 3; EMC Product Standard including specific test methods.
	European Union 73/23/EEC Low Voltage Directive compliant with: • EN 60204-1:1997 - Safety of Machinery - Electrical Equipment of Machines. • EN 50178:1997 - Electronic Equipment for use in Power Installations.
Functional Safety	• EN 60204-1:1997 - Safety of Machinery - Electrical Equipment of Machines. • IEC 61508: Part 1-7:2000 - Functional Safety of Electrical/Electronic/ Programmable Electronic Safety-related Systems. • EN954-1:1996 - Safety of machinery. Safety related parts of control systems. Part 1: General principles for design.

(1) Refer to http://www.rockwellautomation.com/products/certification for Declarations of Conformity Certificates.

AC Line Filter Specifications

The tables below contain specifications for ac line filters available for Kinetix 6000 servo drive systems.

AC Line Filter Specifications

AC Line Filter Catalog Number	Specifications								
	Voltage	Phase	Current	Power Loss W	Leakage Current mA	Weight kg (lb)	Humidity	Vibration	Operating Temperature
2090-XXLF-X330B	500V ac 50/60 Hz	Three	30A @ 50° C (122° F)	38	64	2.7 (5.9)	90% RH	10-200 Hz @ 1.8 g	-25 to 85° C (-13 to 185 ° F)
2090-XXLF-375			75A @ 50° C (122° F)	57	50	5.2 (11.4)			
2090-XXLF-375B					108				
2090-XXLF-3100			100A @ 50° C (122° F)	75	73	9.5 (20.9)			

AC Line Filter Selection

Drive Catalog Number	AC Line Filter Catalog Number
2094-AC05-MP5-S	2090-XXLF-X330B
2094-AC05-M01-S	
2094-AC09-M02-S	
2094-AC16-M03-S	2090-XXLF-375
2094-AC32-M05-S	2090-XXLF-3100
2094-BC01-MP5-S	2090-XXLF-X330B
2094-BC01-M01-S	
2094-BC02-M02-S	
2094-BC04-M03-S	2090-XXLF-375B
2094-BC07-M05-S	2090-XXLF-3100

External Shunt Module Specifications

External shunt modules are used with Kinetix 6000 drives when regenerative loads exceed the capacity of the internal (IAM or AM) shunt resistor.

Passive shunt modules wire to the Kinetix 6000 (rail mounted) shunt module, catalog number 2094-BSP2.

External Passive Shunt Module Specifications

External Shunt Catalog Number	Drive Voltage V ac	Specifications					Bussmann Replacement Fuse
		Resistance Ω	Peak Power kW	Peak Current A	Cont. Power W	Shipping Weight kg (lb)	
1394-SR9A	230 (1)	4	41.0	101.25	300	3.63 (8)	FNQ-R-20-R1 (1)
	460		160.0	20.0			FWP50A14F
1394-SR9AF	230 (1)	4	41.0	101.25	900	3.63 (8)	FNQ-R-20-R1(1)
	460		160.0	20.0			FWP50A14F
1394-SR36A	230 (1)	4	41.0	101.25	1800	8.6 (19)	FNQ-R-20-R1 (1)
	460		160.0	20.0			FWP50A14F
1394-SR36AF	230 (1)	4	41.0	101.25	3600	9.0 (20)	FNQ-R-25-R1 (1)
	460		160.0	20.0			FWP50A14F

(1) Requires the use of an FNQ fuse with an adapter to allow the smaller body fuse to fit the larger FWP fuse holder.

Bulletin 1336 external active shunt modules wire directly to the dc bus.

External Active Shunt Module Specifications

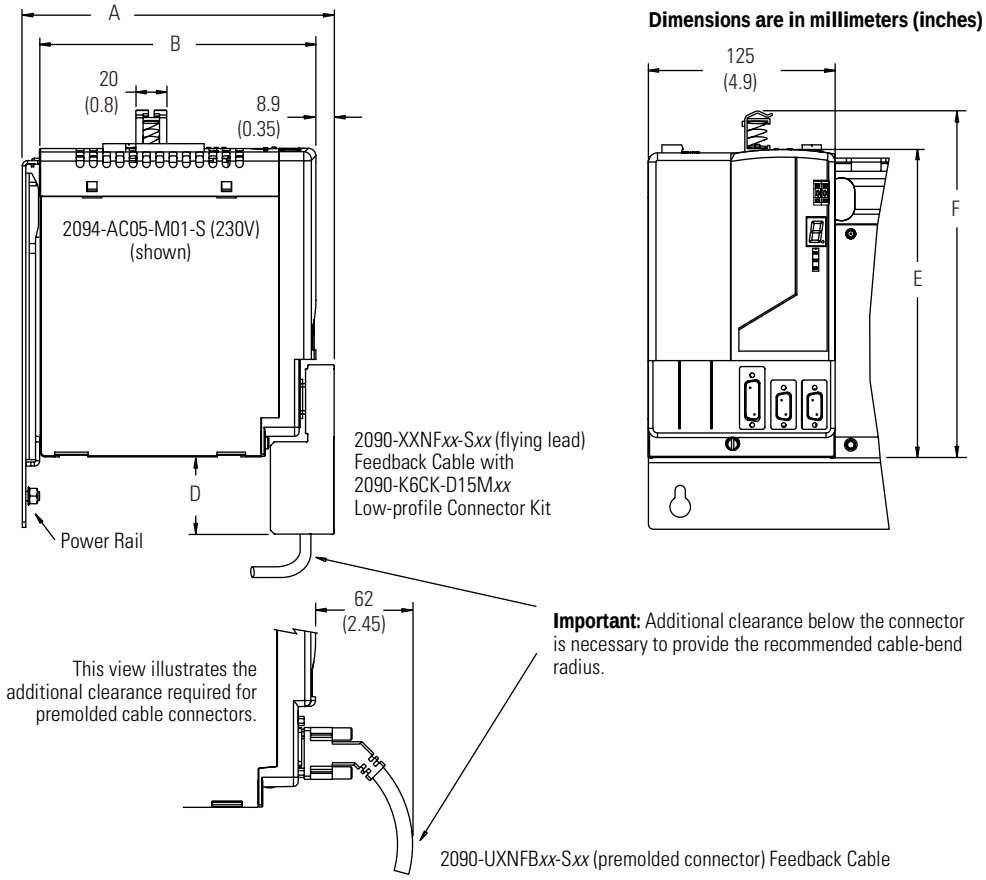
Kinetix 6000 Drives	Shunt Module Catalog Number	Specifications						Fuse Replacement
		Drive Voltage V ac	Resistance Ω	Peak Power kW	Peak Current A	Continuous Power W	Shipping Weight kg (lb)	
2094-AC*xx*-M*xx*	1336-MOD-KA005	230V	28.0	6	15	375	6.8 (15)	A50P10
	1336-MOD-KA010		13.2	12	30	750		A50P20
2094-BC*xx*-M*xx*	1336-MOD-KB005	460V	104.0	6	7.5	375		A60Q
	1336-MOD-KB010		52.0	12	15	750		A60Q
	1336-MOD-KB050		10.0	60	76	3750	33.8 (75)	A70QS35

Refer to the Common DC Bus Selection Guide, publication DRIVES-SG001, for dimensions and catalog number information for the Bulletin 1336 active shunt modules.

Product Dimensions

This section contains product dimensions for your Kinetix 6000 system components.

Integrated Axis Module Dimensions
2094-AC05-MP5-S, AC05-M01-S, and -AC09-M02-S (230V)
2094-BC01-MP5-S, -BC01-M01-S, and -BC02-M02-S (460V)

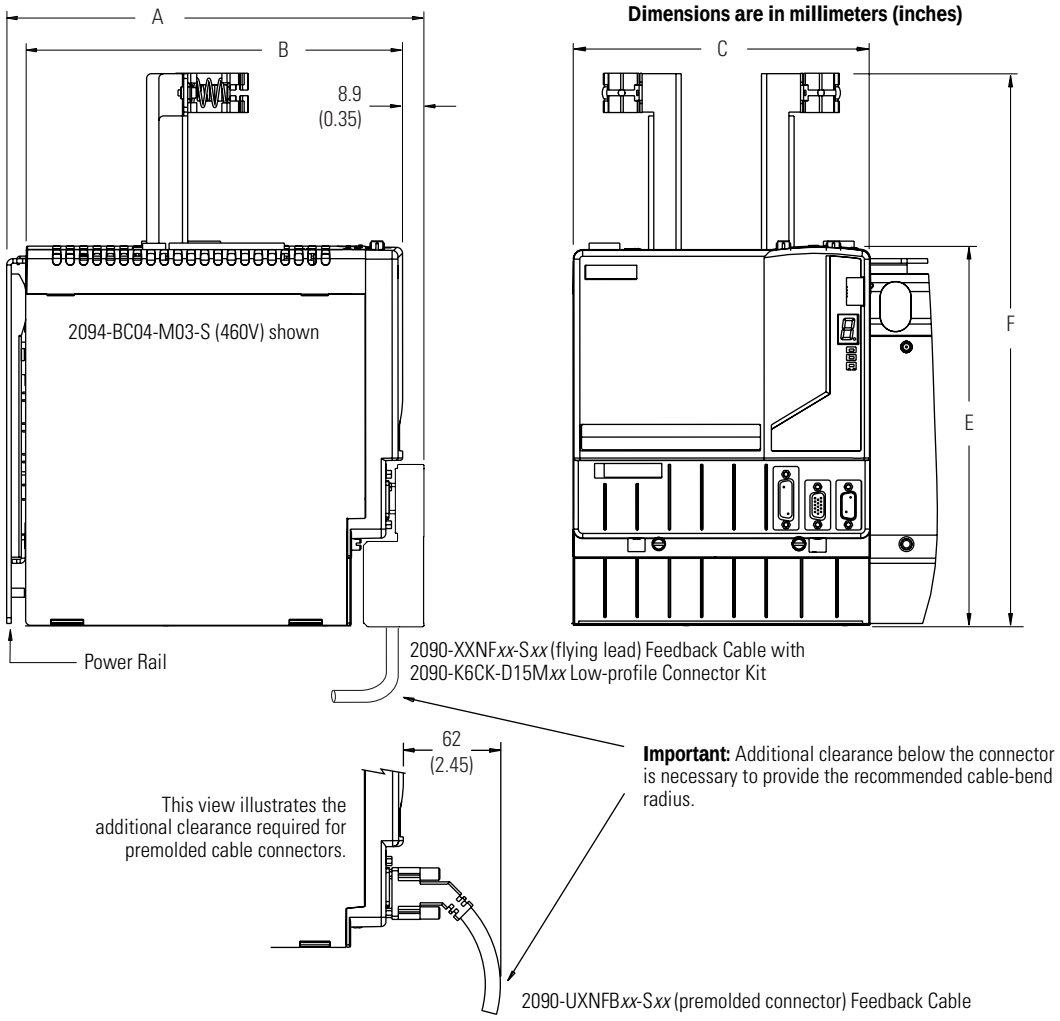


Modules are shown mounted to the power rail and the dimensions reflect that in the depth of the module.

IAM Dimensions

Kinetix 6000 IAM	A mm (in.)	B mm (in.)	D mm (in.)	E mm (in.)	F mm (in.)
2094-AC05-MP5-S	198 (7.8)	176 (7.0)	51 (2.0)	206 (8.2)	231 (9.1)
2094-AC05-M01-S					
2094-AC09-M02-S					
2094-BC01-MP5-S	272 (10.7)	249 (9.8)	0 (0)	256 (10.1)	281 (11.0)
2094-BC01-M01-S					
2094-BC02-M02-S					

Integrated Axis Module Dimensions
2094-AC16-M03-S and -AC32-M05-S (230V)
2094-BC04-M03-S and -BC07-M05-S (460V)

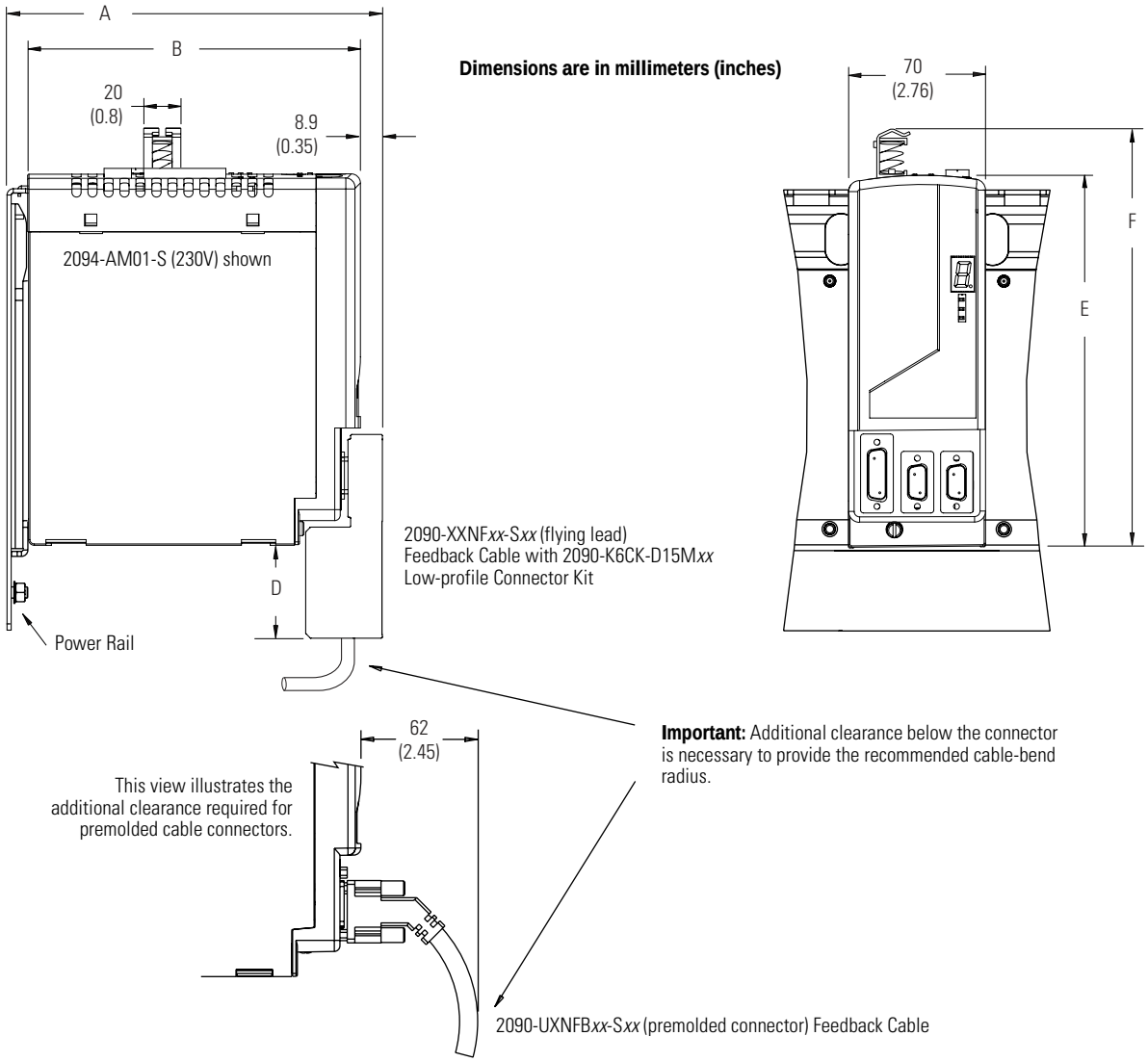


Modules are shown mounted to the power rail and the dimensions reflect that in the depth of the module.

IAM Dimensions

Kinetix 6000 IAM	A mm (in.)	B mm (in.)	C mm (in.)	E mm (in.)	F mm (in.)
2094-AC16-M03-S	198 (7.8)	176 (7.0)	125 (4.9)	302 (11.9)	420 (16.5)
2094-AC32-M05-S			196 (7.7)		
2094-BC04-M03-S	272 (10.7)	249 (9.8)	196 (7.7)	256 (10.1)	374 (14.7)
2094-BC07-M05-S				318 (12.5)	436 (17.2)

Axis Module Dimensions
2094-AMP5-S, -AM01-S, and -AM02-S (230V)
2094-BMP5-S, -BM01-S, and -BM02-S (460V)

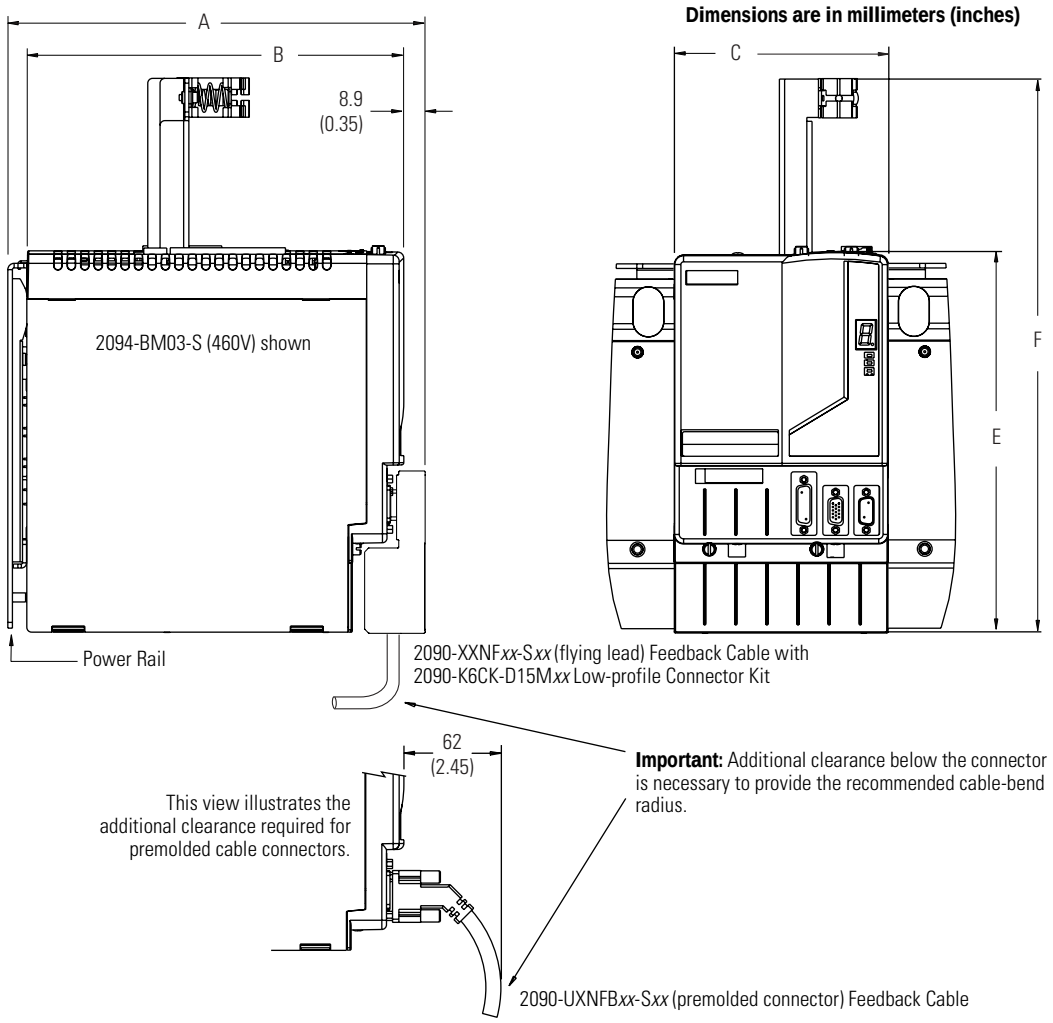


Modules are shown mounted to the power rail and the dimensions reflect that in the depth of the module.

AM Dimensions

Kinetix 6000 AM	A mm (in.)	B mm (in.)	D mm (in.)	E mm (in.)	F mm (in.)
2094-AMP5-S	198 (7.8)	176 (7.0)	51 (2.0)	206 (8.2)	231 (9.1)
2094-AM01-S					
2094-AM02-S					
2094-BMP5-S	272 (10.7)	249 (9.8)	0 (0)	256 (10.1)	281 (11.0)
2094-BM01-S					
2094-BM02-S					

Axis Module Dimensions
2094-AM03-S and -AM05-S (230V)
2094-BM03-S and -BM05-S (460V)

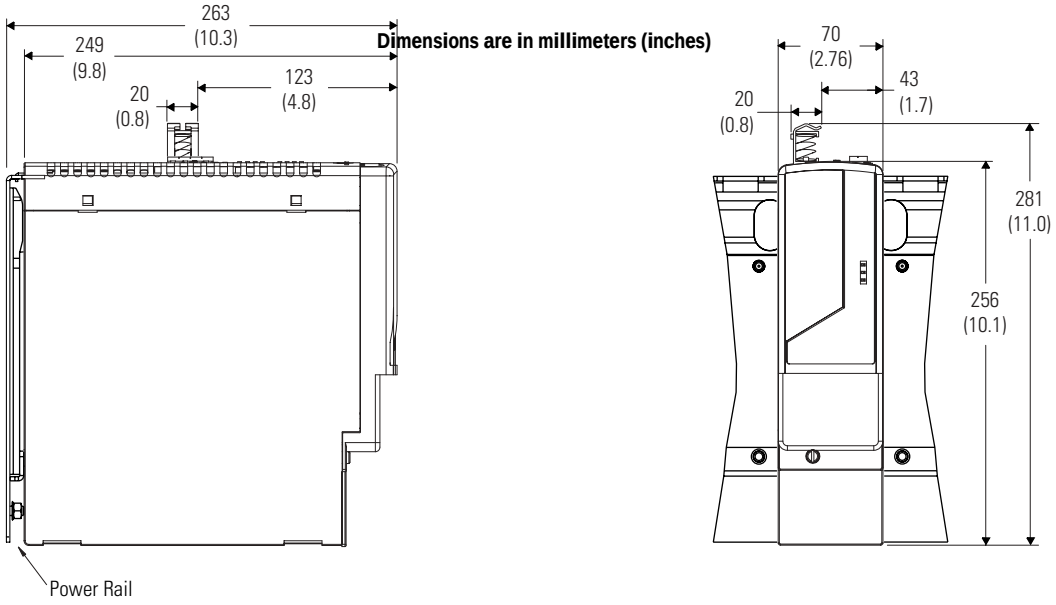


Modules are shown mounted to the power rail and the dimensions reflect that in the depth of the module.

AM Dimensions

Kinetix 6000 AM	A mm (in.)	B mm (in.)	C mm (in.)	E mm (in.)	F mm (in.)
2094-AM03-S	198 (7.8)	176 (7.0)	70 (2.8)	302 (11.9)	420 (16.5)
2094-AM05-S					
2094-BM03-S	272 (10.7)	249 (9.8)	141 (5.5)	256 (10.1)	374 (14.7)
2094-BM05-S				318 (12.5)	436 (17.2)

Shunt Module Dimensions
2094-BSP2



Modules are shown mounted to the power rail and the dimensions reflect that in the depth of the module.

Interconnect Diagrams

Introduction

This appendix provides wiring examples and system block diagrams for your Kinetix 6000 system components.

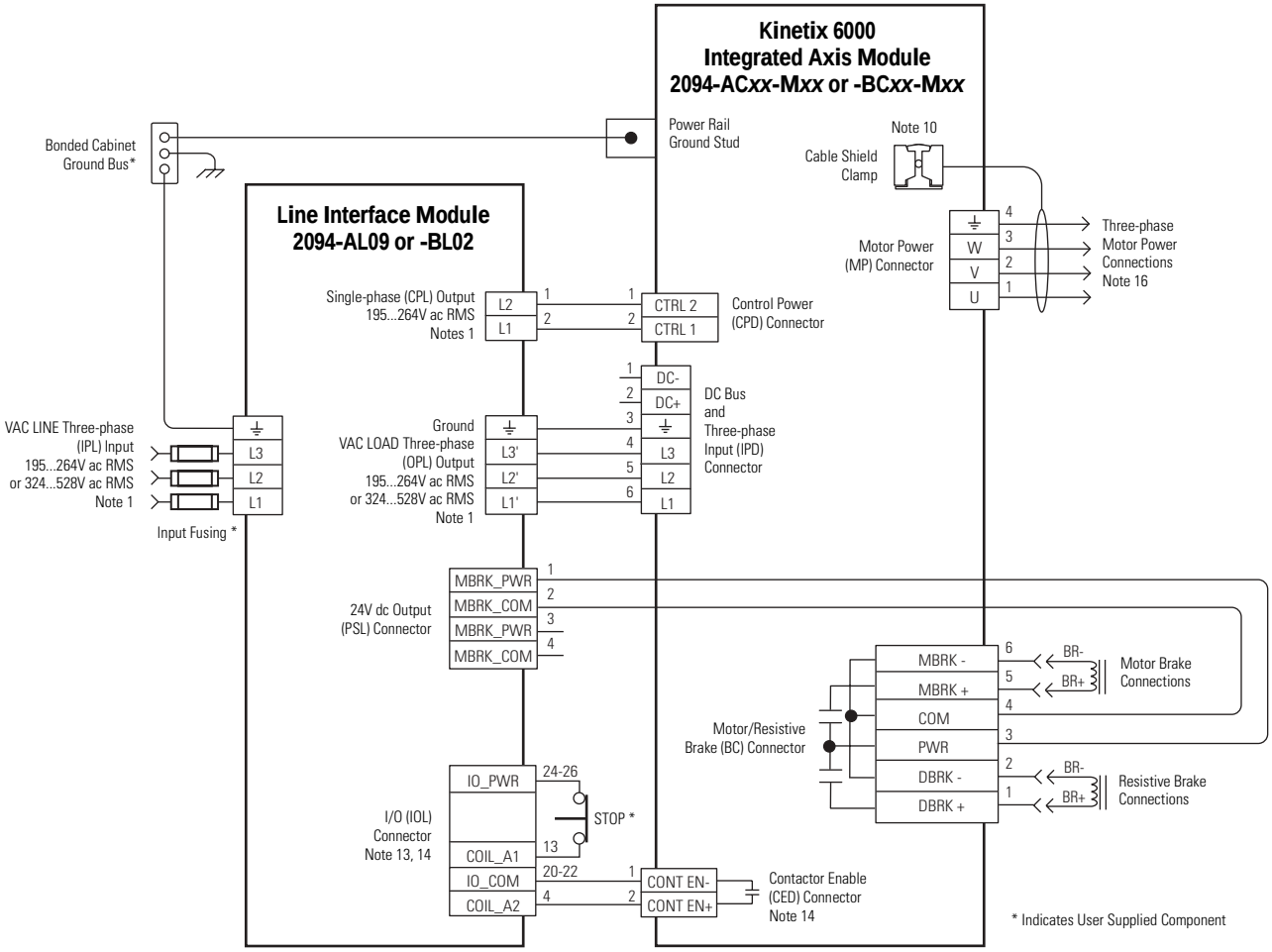
Wiring Examples

This appendix provides wiring examples to assist you in wiring the Kinetix 6000 system. The notes below apply to the wiring examples on the pages that follow.

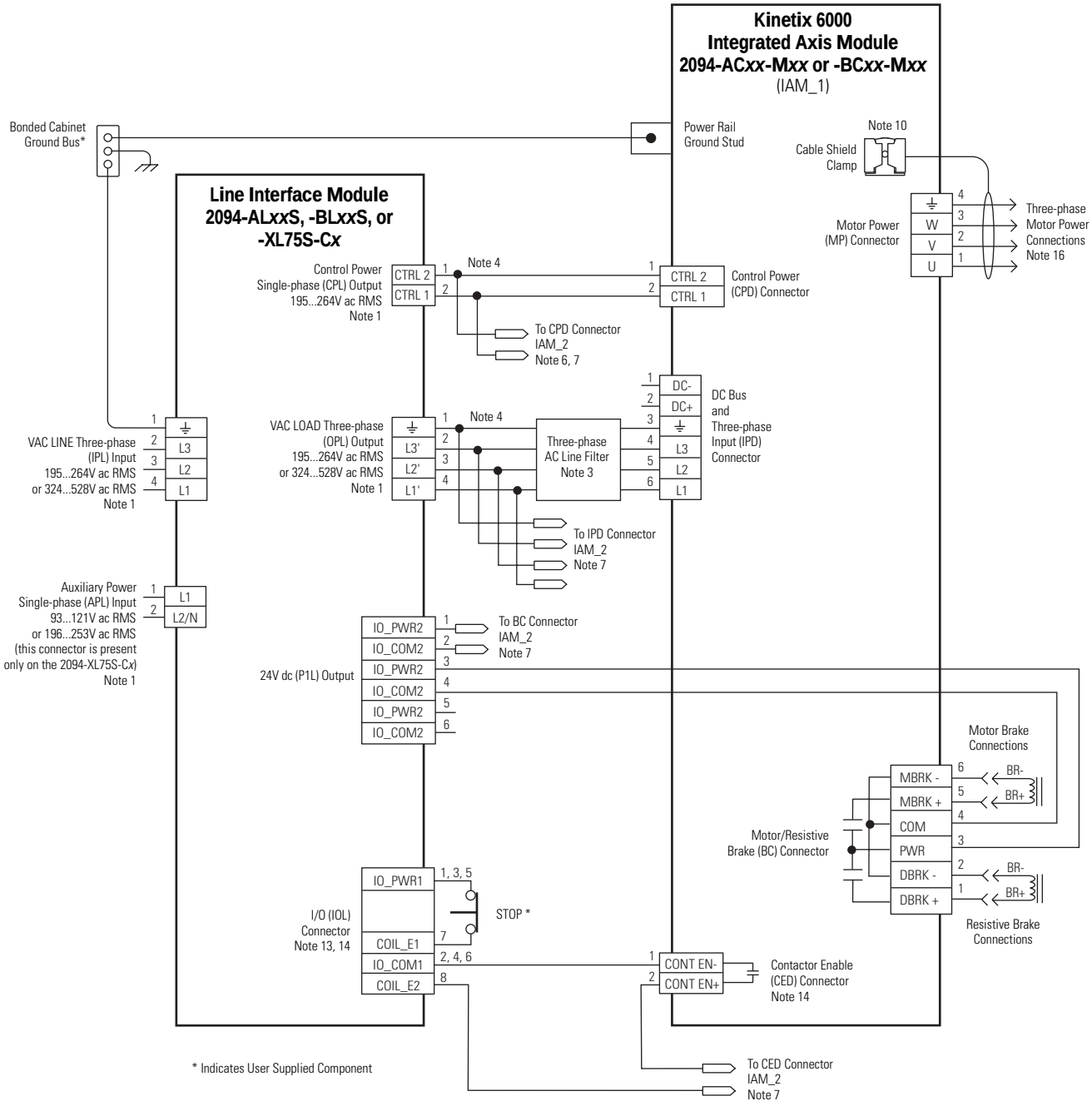
Note	Information
1	For power wiring specifications, refer to Power Wiring Requirements on page 80.
2	For input fuse and circuit breaker sizes, refer to Circuit Breaker/Fuse Specifications on page 177.
3	Place ac (EMC) line filters as close to the drive as possible and do not route very dirty wires in wireway. If routing in wireway is unavoidable, use shielded cable with shields grounded to the drive chassis and filter case. For ac line filter specifications, refer to AC Line Filter Specifications on page 183.
4	Terminal block is required to make connections.
5	2094-BC*xx*-M*xx* (460V) IAM requires step down transformer for single-phase control power input. Source 2094-AC*xx*-M*xx* (230V) IAM control power from the three-phase input power (line-to-line). Supplying 230V control power from any other source requires an isolation transformer. If used, do not ground either leg of the isolation transformer output.
6	LIM models 2094-AL*xx*S and -BL*xx*S can supply a maximum of eight axes. LIM models 2094-XL75S-C*x* can supply a maximum of sixteen axes. For common bus systems with more than sixteen axes, multiple LIMs (or control power transformers) are required.
7	LIM models 2094-AL*xx*S, -BL*xx*S, and -XL75S-C*x* are capable of connecting to two IAMs, providing each IAM has its own line filter and the maximum current specification is not exceeded.
8	Contactor coil (M1) needs integrated surge suppressors for ac coil operation. Refer to Contactor Ratings on page 179.
9	Drive Enable input must be opened when main power is removed, or a drive fault will occur. A delay of at least 1.0 second must be observed before attempting to enable the drive after main power is restored.
10	Cable shield clamp must be used in order to meet CE requirements. No external connection to ground is required.
11	Default configuration for jumper is for grounded power at user site. Ungrounded sites must jumper the bleeder resistor to prevent high electrostatic buildup. Refer to Determining Your Type of Input Power on page 71 for more information.
12	Leave jumper between PR2 and PR3 as shown to utilize the internal pre-charge resistor. Remove jumper when external pre-charge/circuit is required. For more information, refer to the 8720MC Regenerative Power Supply Installation Manual, publication 8720MC-RM001.
13	**ATTENTION**  Implementation of safety circuits and risk assessment is the responsibility of the machine builder. Please reference international standards EN 1050 and EN 954 estimation and safety performance categories. For more information refer to Understanding the Machinery Directive, publication SHB-900.
14	**ATTENTION**  Wiring the contactor enable relay is required. To avoid personal injury or damage to the drive, wire the contactor enable relay into your safety control string. Refer to Contactor Enable Relay on page 63, for more information. The recommended minimum wire size for wiring the safety circuit to the contactor enable connector is 1.5 mm^2 (16 AWG).
15	The Kinetix 6000 axis module referenced is either an individual axis module (2094-*x*M*xx*) or the same axis module that resides within an integrated axis module (2094-*x*C*xx*-M*xx*).
16	For motor cable specifications, refer to the Kinetix Motion Control Selection Guide, publication GMC-SG001.
17	Wire colors are for flying lead cable (2090-XXNF*xx*-S*xx*) and may vary from the premolded connector cable (2090-UXNFB*xx*-S*xx*).
18	Y-Series feedback cables have a drain wire that must be folded back under the low-profile connector clamp.
19	Only the MPG-B*xxx* encoder uses the +5V dc supply. MPL-B3*xx*, -B4*xx*, -B45*xx*, -B5*xx*, -B6*xx*, -B8*xx*, -B9*xx*, encoders use the +9V dc supply.
20	MPL-A3*xx*, -A4*xx*, -A45*xx*, and MPG-A*xxx* encoders use the +5V dc supply. Only the MPL-A5*xx* encoder uses the +9V dc supply.
21	MPL-A15*xx*, -A2*xx*, MPF-A3*xx*, -A4*xx*, -A45*xx*, and MPS-A*xxx* encoders use the +5V dc supply. MPL-B15*xx*, -B2*xx*, MPF -A5*xx*, -B*xxx*, and MPS-B*xxx* encoders use +9V dc.
22	Brake wires on MPF-A/B5*xx* motors are labeled plus (+) and minus (-). All other MP-Series motor brake wires are labeled F and G.
23	Refer to 1336 Active Shunt Input Fuse Specifications for input fuse specifications. Current requirements are for master only shunt applications. For master/slave applications, you must multiply the current requirement by the number of shunt units.
24	Refer to 1336 Active Shunt Fault Relay Specifications for fault relay specifications. This normally closed contact (TTL compatible) is closed when 115V ac is applied and opens when a shunt fault or loss of power occurs.

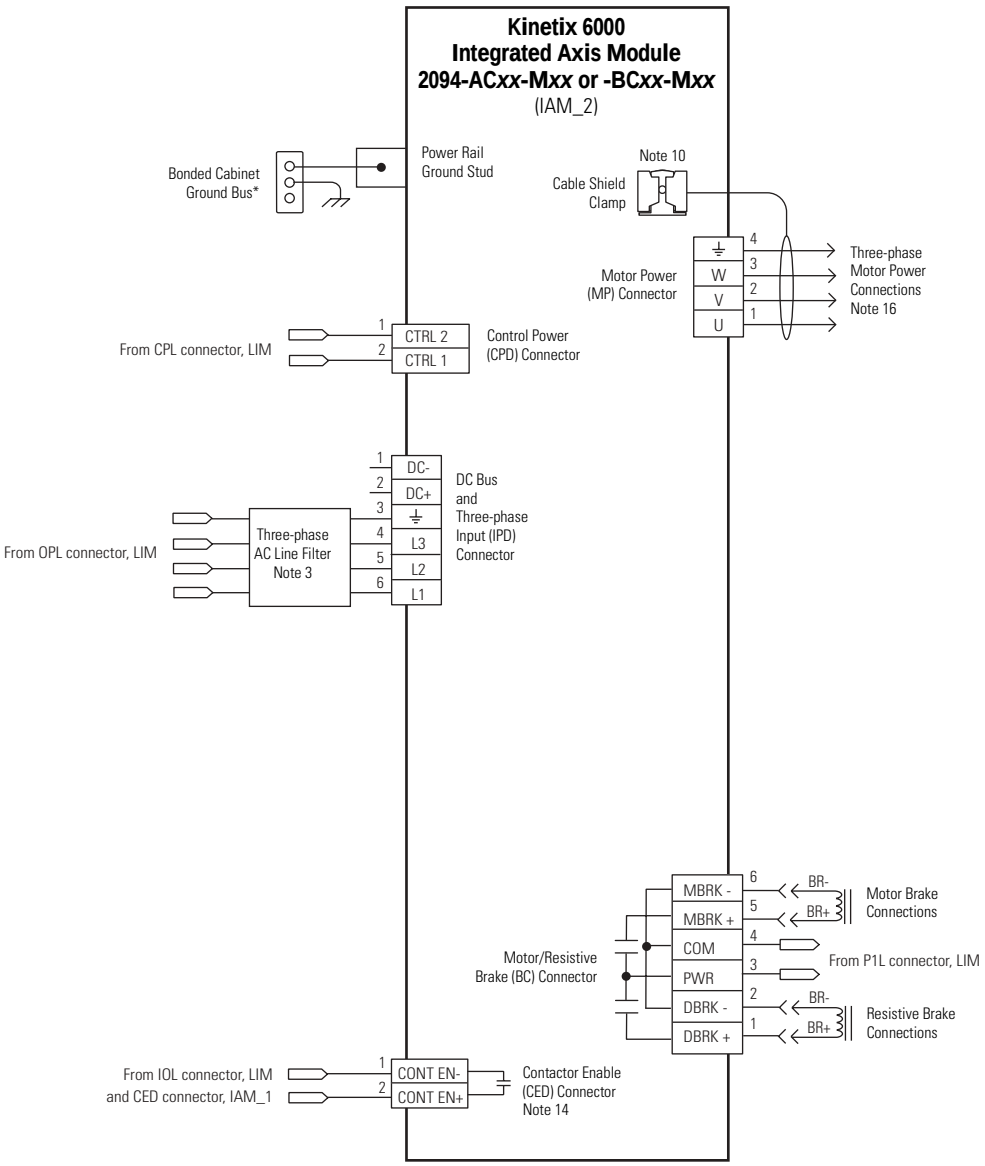
Power Wiring Examples

Single IAM Wiring Example with LIM (2094-AL09 or -BL02)



Multiple IAM Wiring Example with LIM (2094-AL*xx*S, -BL*xx*S, or -XL75S)




Kinetix 6000
Integrated Axis Module
2094-ACxx-Mxx or -BCxx-Mxx
(IAM_2)
Bonded Cabinet Ground Bus*
Power Rail Ground Stud
Note 10
Cable Shield Clamp
Motor Power (MP) Connector
4
3
2
1
W
V
U
Three-phase Motor Power Connections Note 16
From CPL connector, LIM
CTRL 2
CTRL 1
Control Power (CPD) Connector
DC-
DC+
L3
L2
L1
DC Bus and Three-phase Input (IPD) Connector
From OPL connector, LIM
Three-phase AC Line Filter Note 3
MBRK -
MBRK +
COM
PWR
DBRK -
DBRK +
BR-
BR+
Motor Brake Connections
Motor/Resistive Brake (BC) Connector
From P1L connector, LIM
Resistive Brake Connections
From IOL connector, LIM and CED connector, IAM_1
CONT EN-
CONT EN+
Contactor Enable (CED) Connector Note 14

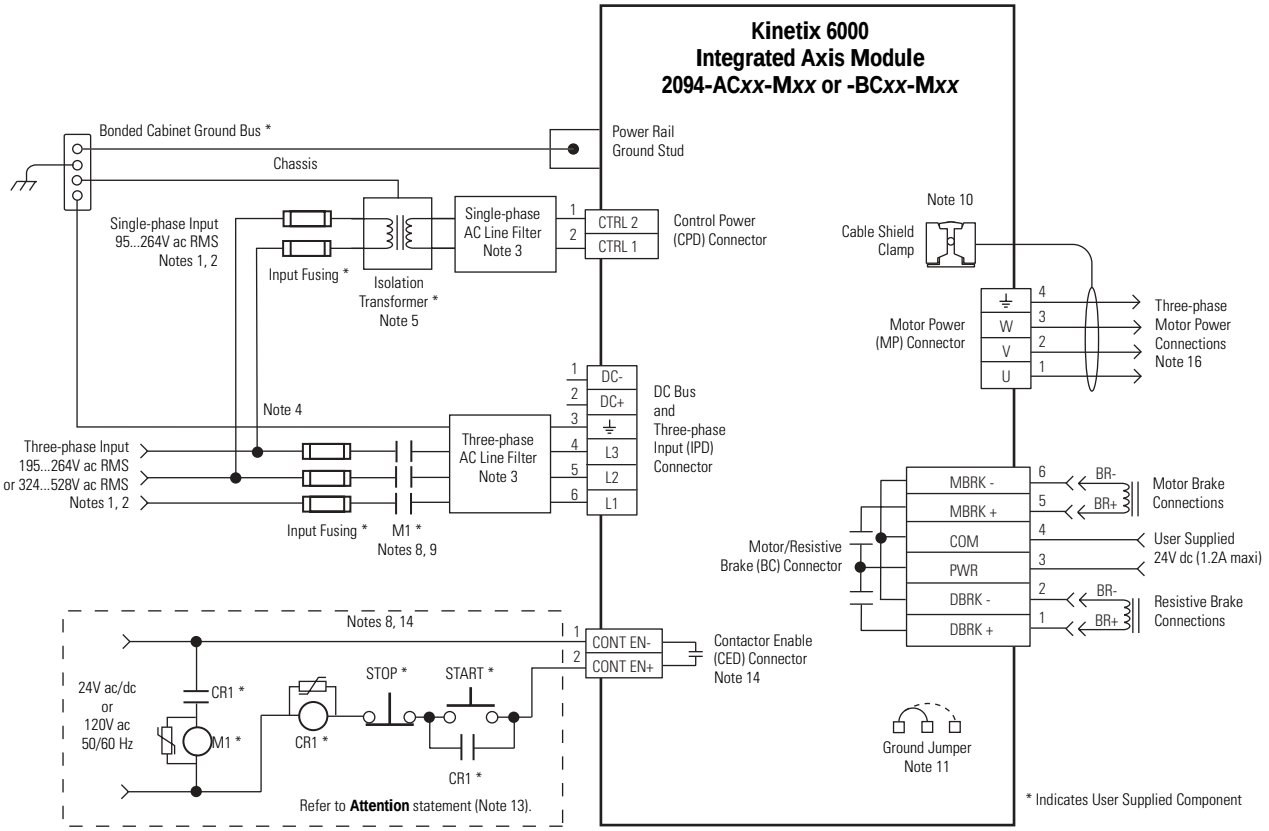
The configuration on this page does not include a LIM. You must supply input power components. The single-phase and three-phase line filters are wired downstream of fusing and the M1 contactor.

ATTENTION

Wiring the contactor enable (CED) relay is required. To avoid injury or damage to the drive, wire the contactor enable relay into your safety control string.

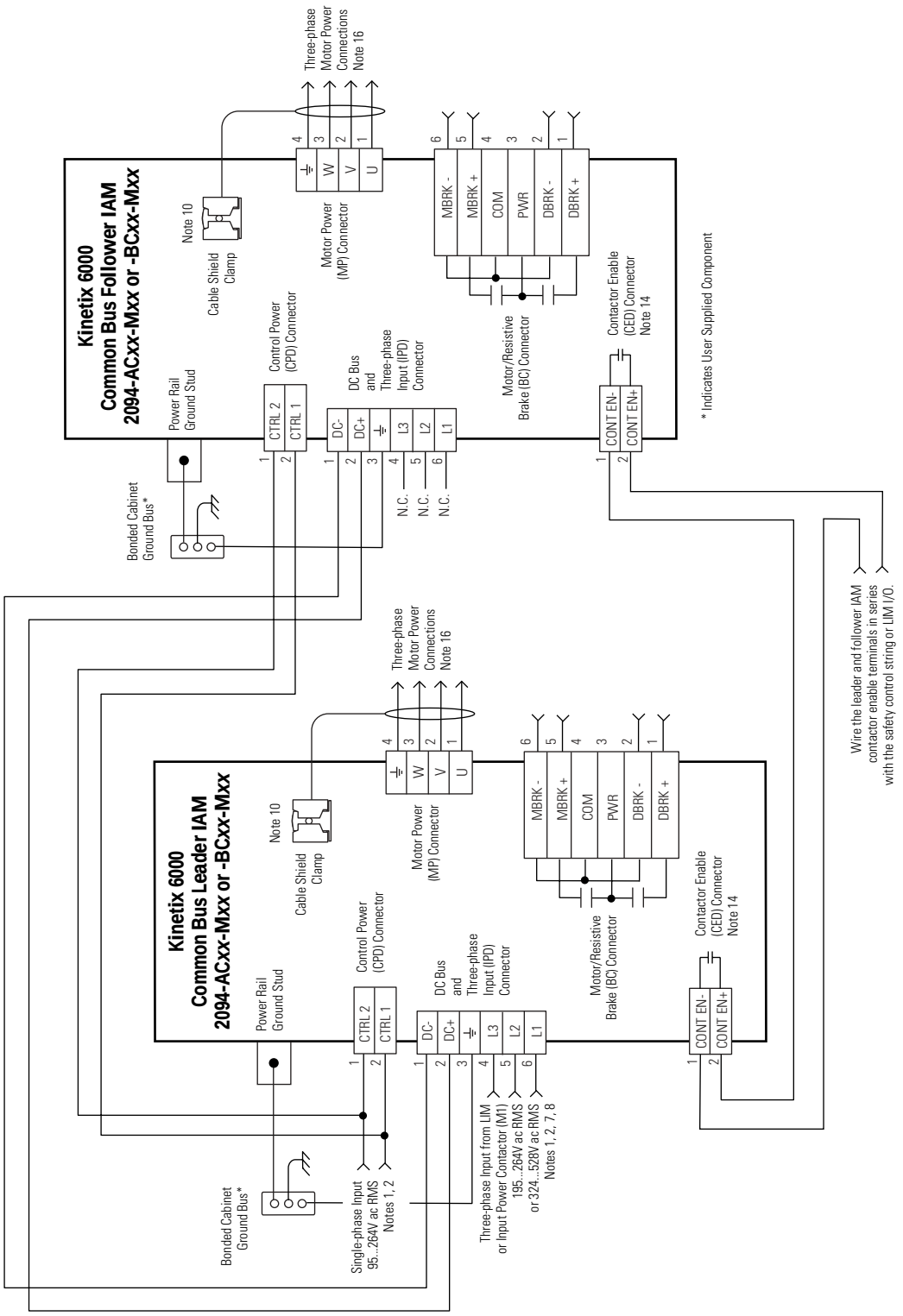
Refer to Contactor Enable Relay on page 63, for more information.

IAM Wiring Example (without LIM)

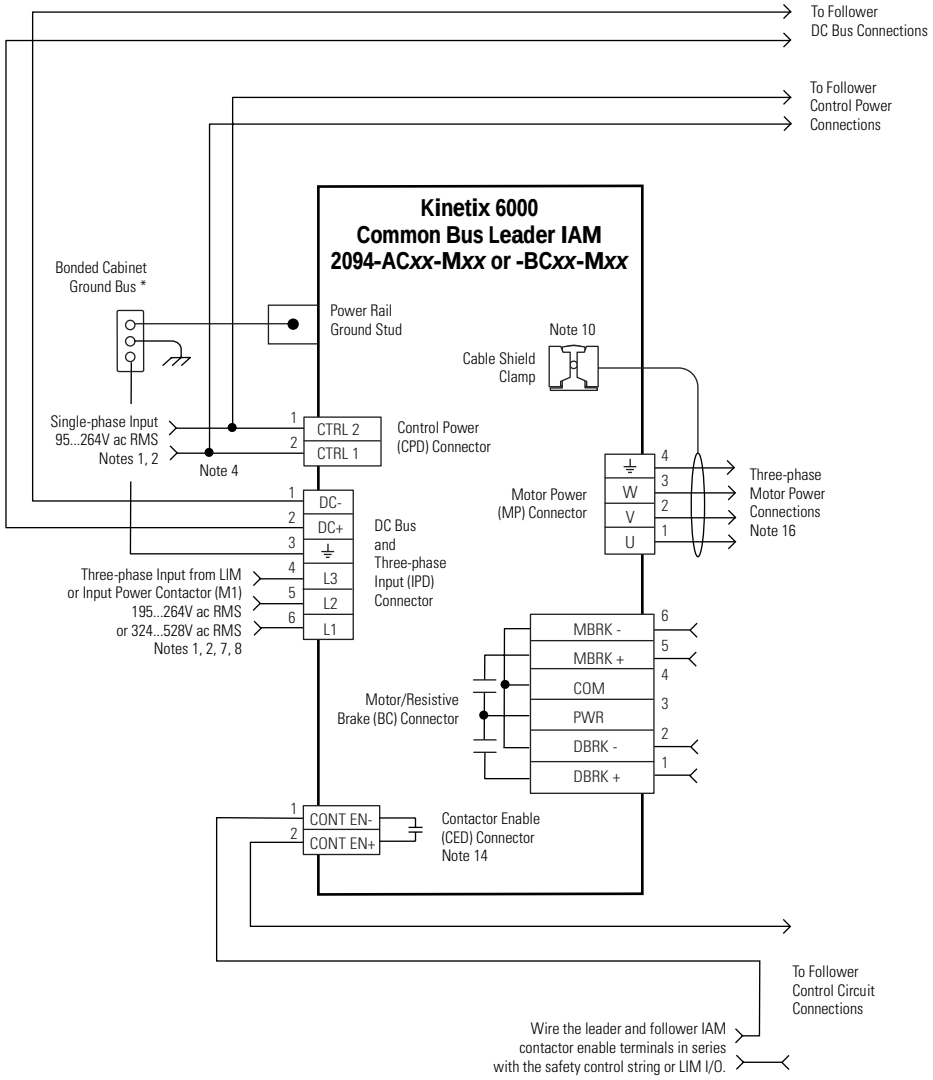


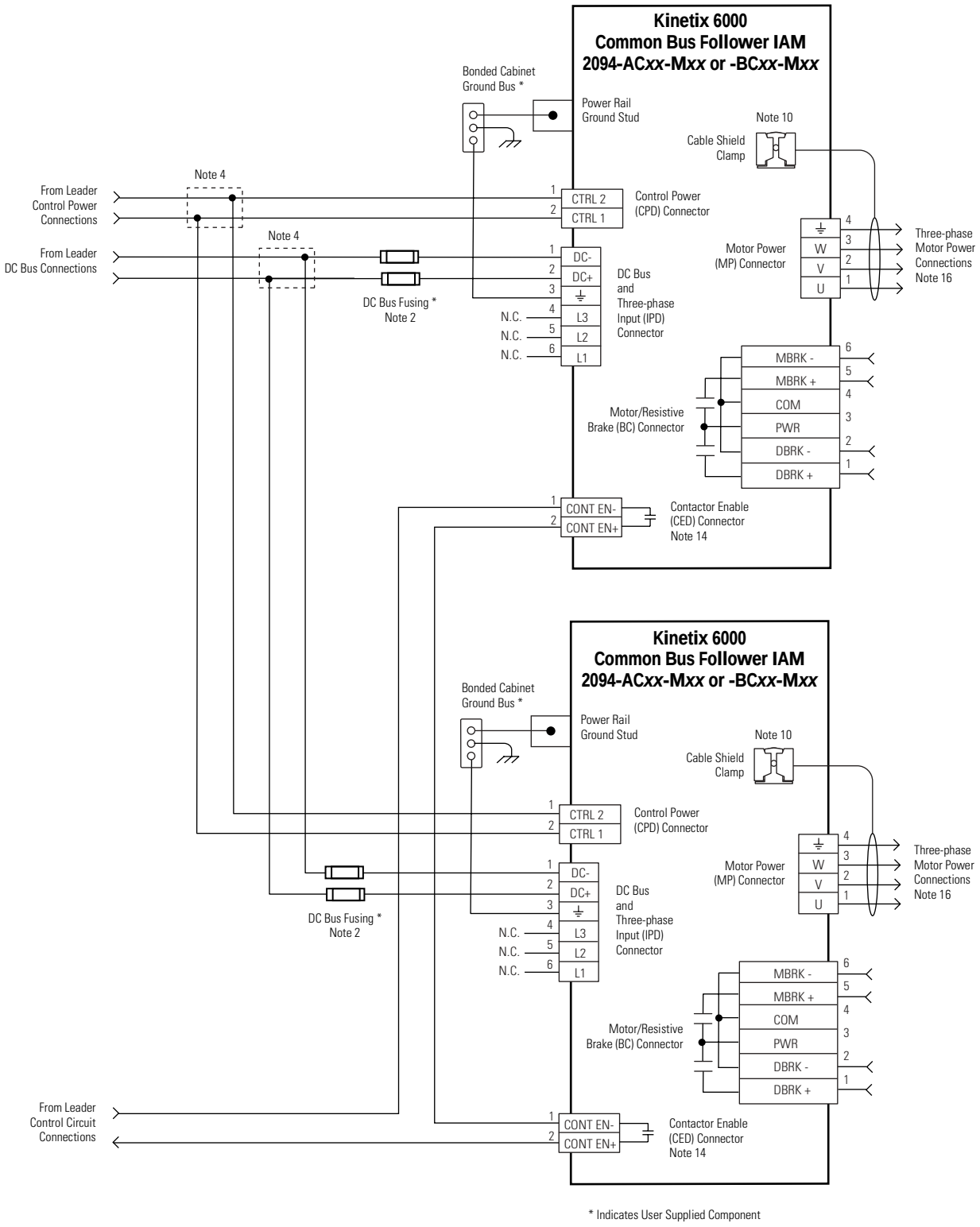
DC Common Bus Wiring Examples

Leader IAM Wiring Example with Single Follower IAM

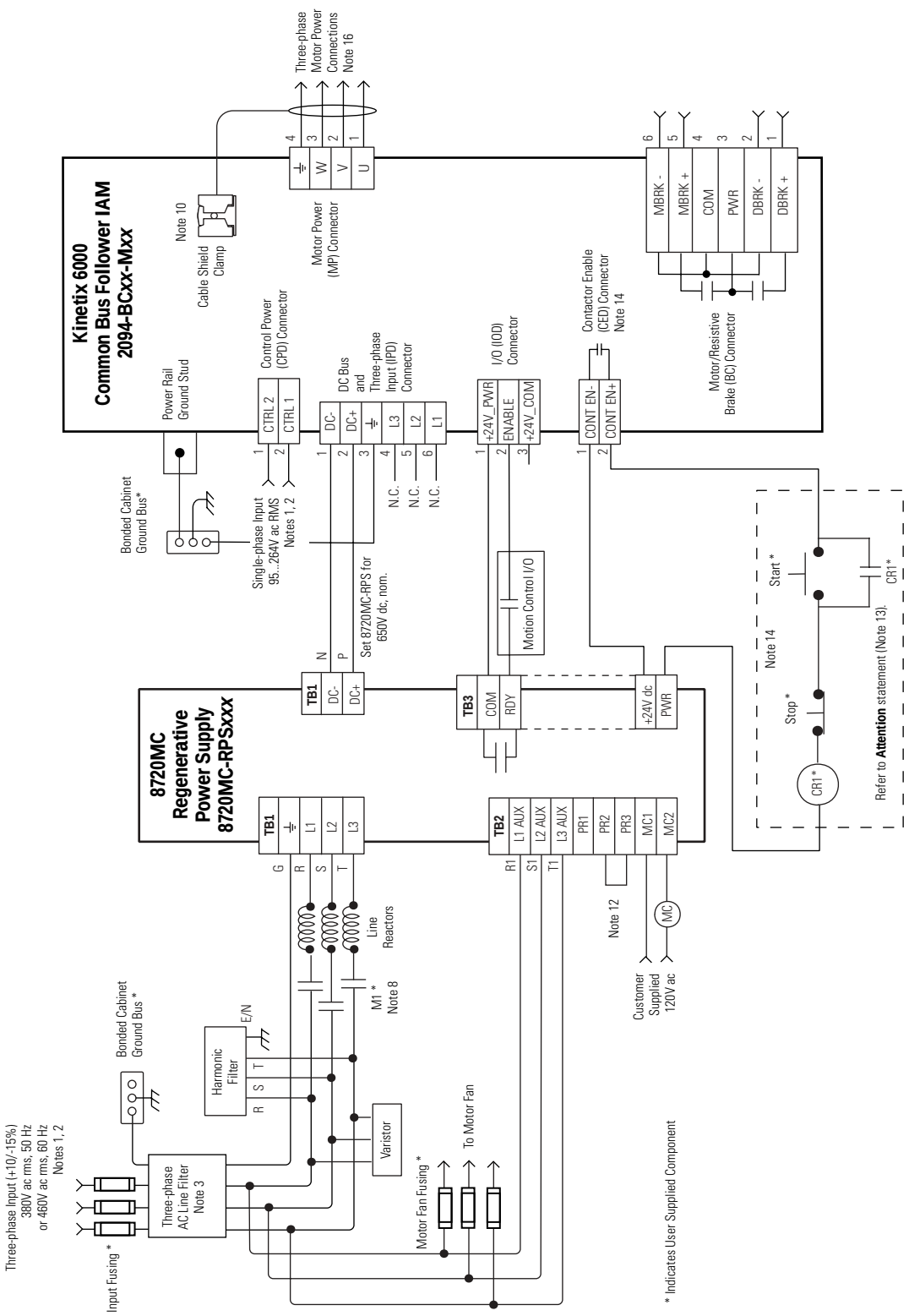


Leader IAM Wiring Example with Multiple Follower IAM




Kinetix 6000
Common Bus Follower IAM
2094-ACxx-Mxx or -BCxx-Mxx
Bonded Cabinet Ground Bus *
Power Rail Ground Stud
Note 10
Cable Shield Clamp
Note 4
From Leader Control Power Connections
From Leader DC Bus Connections
CTRL 2
CTRL 1
Control Power (CPD) Connector
DC-
DC+
DC Bus and Three-phase Input (IPD) Connector
N.C.
L3
L2
L1
DC Bus Fusing * Note 2
Motor Power (MP) Connector
W
V
U
Three-phase Motor Power Connections Note 16
MBRK -
MBRK +
COM
PWR
DBRK -
DBRK +
Motor/Resistive Brake (BC) Connector
CONT EN-
CONT EN+
Contactor Enable (CED) Connector Note 14
From Leader Control Circuit Connections
* Indicates User Supplied Component

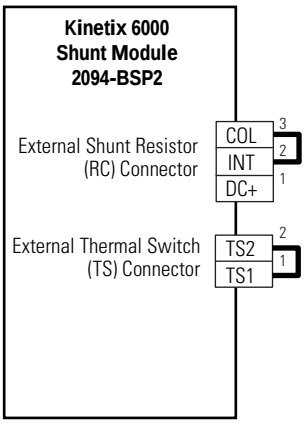
8720MC-RPS Leader Drive Wiring Example with Single Follower IAM



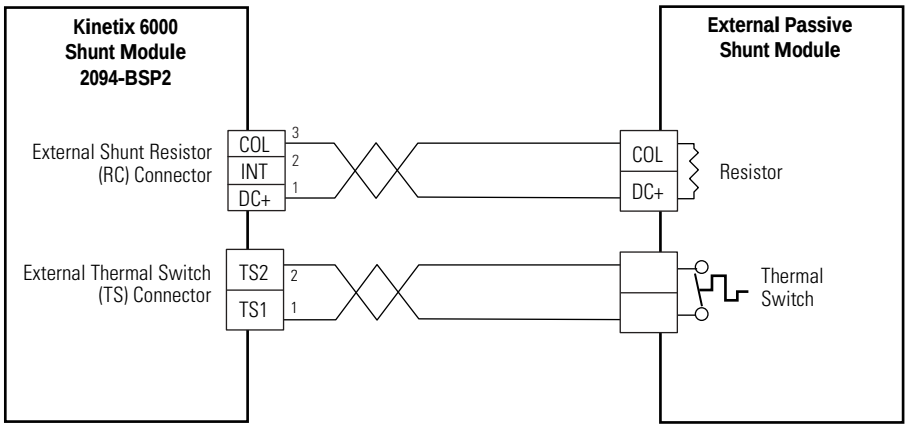
IMPORTANT Use a pushbutton circuit (instead of an SPST toggle switch) in series with the contactor enable string (between the 8720MC-RPS and Kinetix 6000 drive) to allow a drive fault to remove the dc bus power, and to prevent the drive from applying dc bus power without your input after clearing a drive fault.

Shunt Module Wiring Examples

Shunt Module Wired for Internal Operation (default configuration)



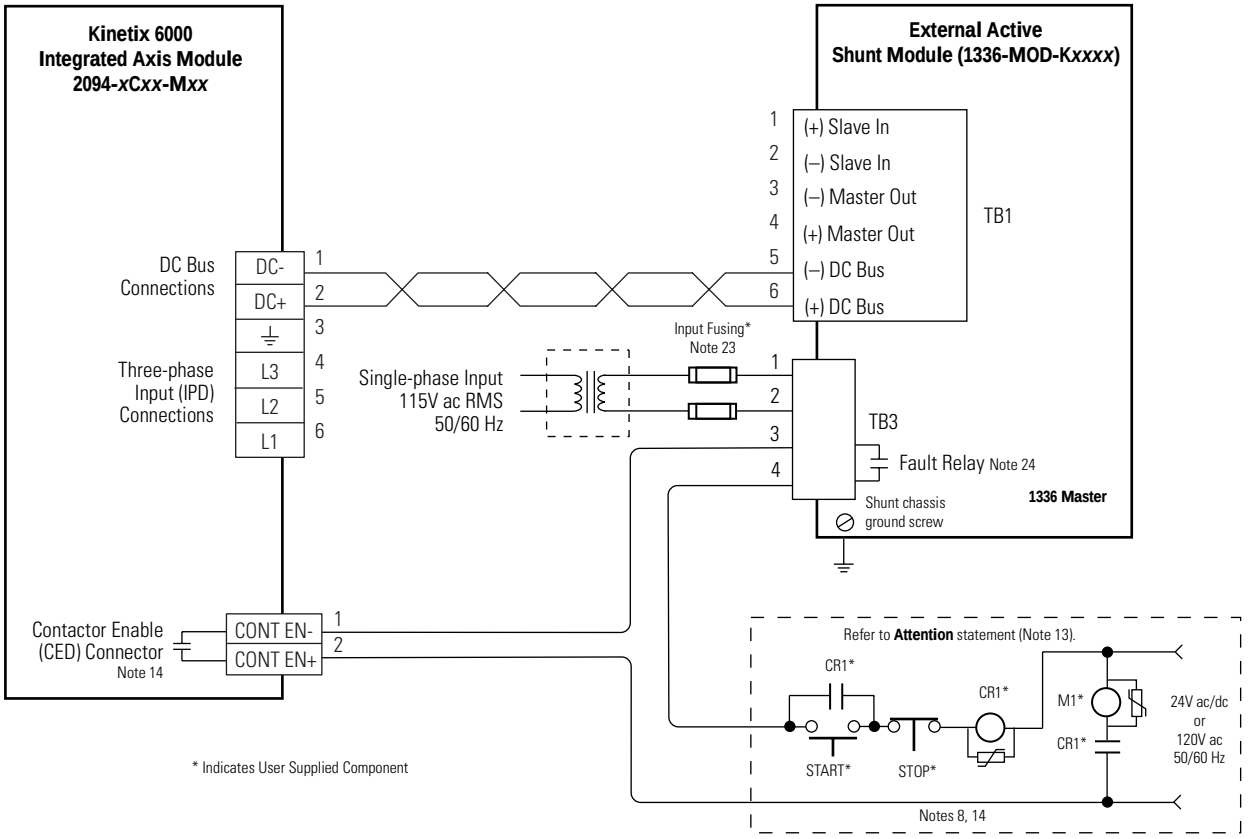
Shunt Module Wiring Example with External Passive Shunt



Refer to External Shunt Module Specifications on page 184, for a list of external passive shunt module catalog numbers available for the Kinetix 6000 drives

IMPORTANT Only passive shunts with a thermal switch are wired to the TS connector on the Kinetix 6000 shunt module. If your external passive shunt does not have a thermal switch, leave the jumper (default configuration) in place on the TS connector.

IAM Wiring Example with Single External Active Shunt



Refer to External Shunt Module Specifications on page 184 for a list of external active shunt module catalog numbers available for the Kinetix 6000 drives.

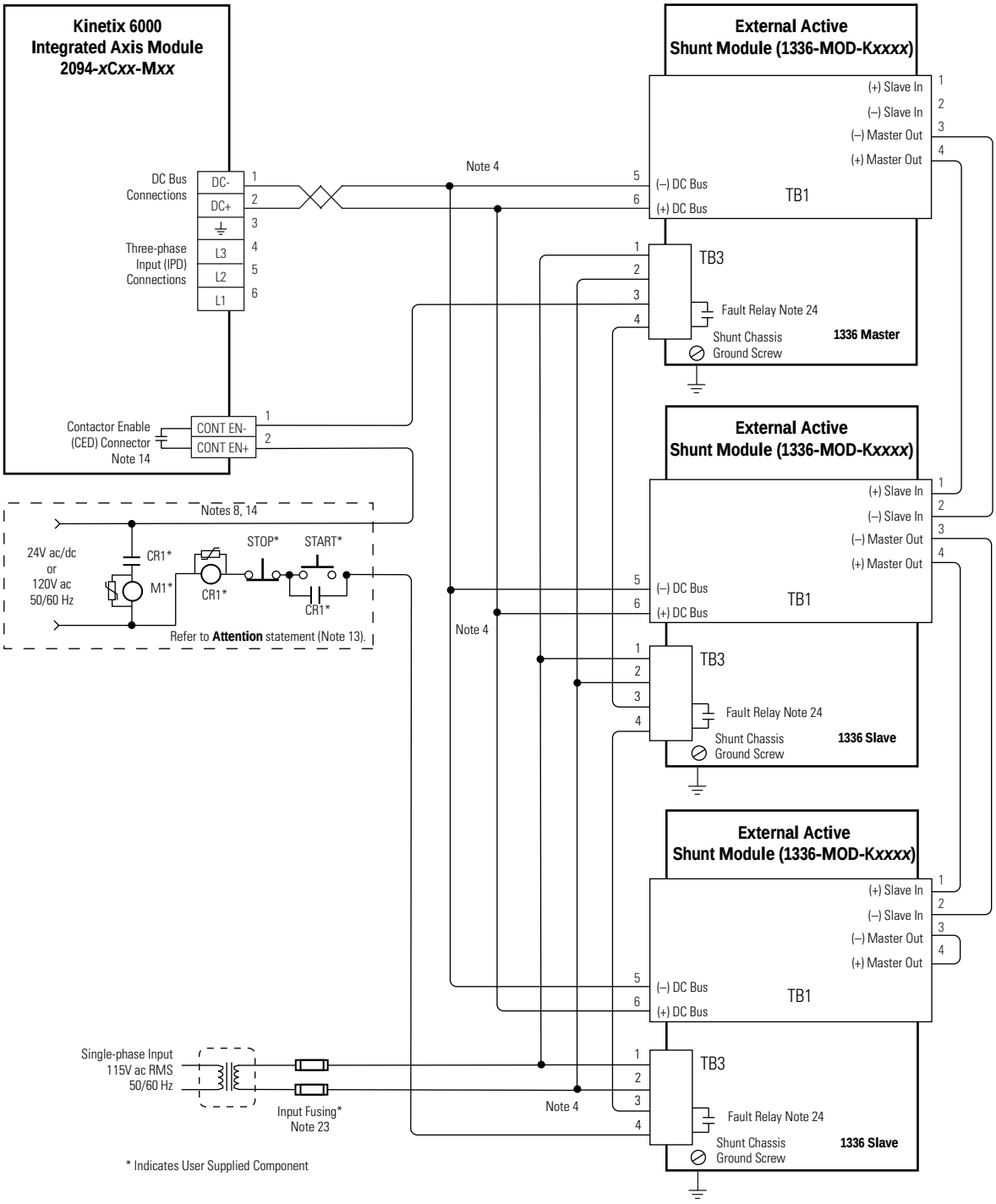
1336 Active Shunt Input Fuse Specifications

Active Shunt Module	Description	Input Current Requirements
1336-K*x*005 or K*x*010	Input current requirement to power logic for fault contact operation.	0.05 A
1336-KB050	Input current requirement to power fan and logic for fault contact operation.	0.65 A

1336 Active Shunt Fault Relay Specifications

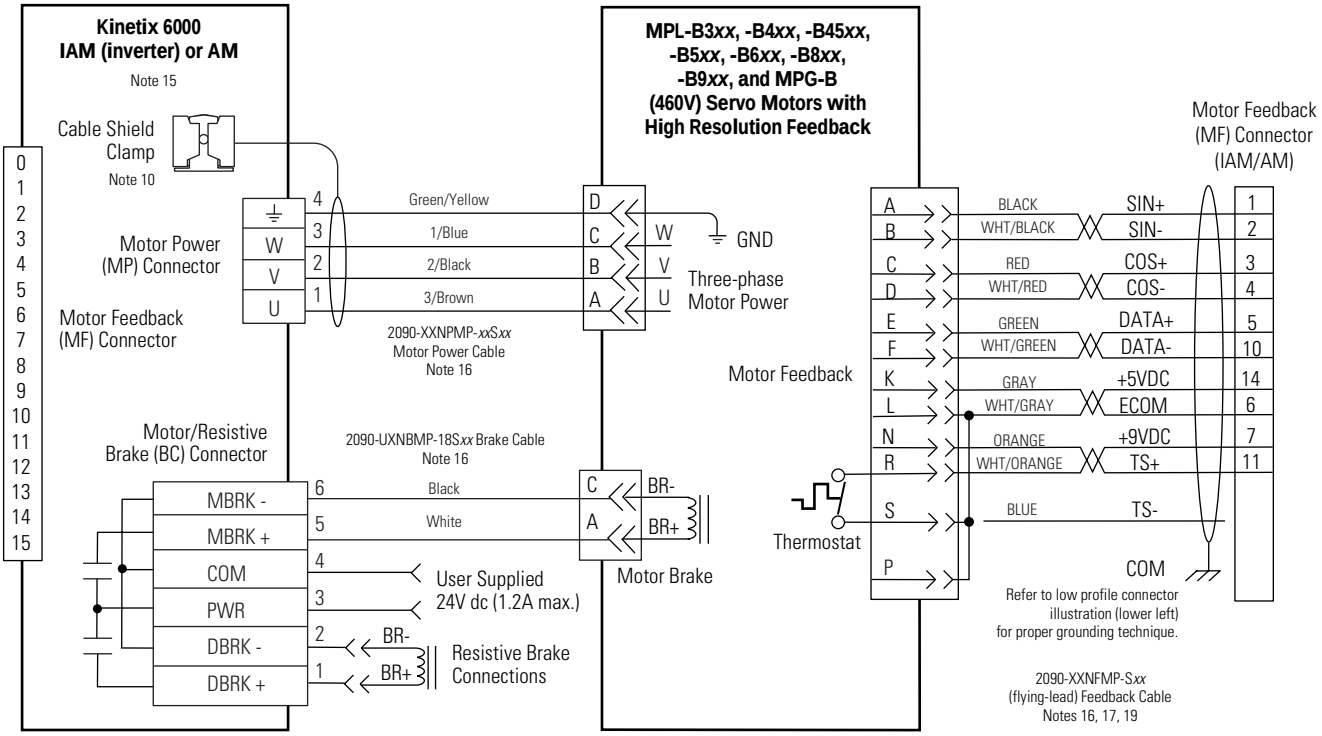
Parameter	Description	120V ac	30V ac
On-state current	Current flow when the contact is closed	0.6 A	2.0 A
On-state resistance	Contact resistance (max)	50 m Ω	50 m Ω
Off-state voltage	Voltage across the contacts when the relay is open	120V ac	30V ac

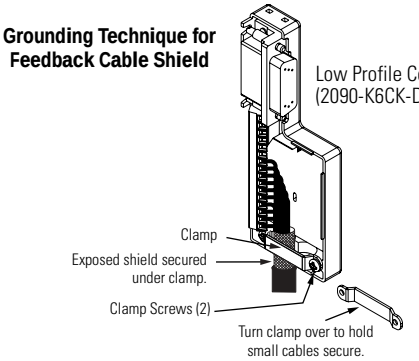
IAM Wiring Example with Multiple External Active Shunts

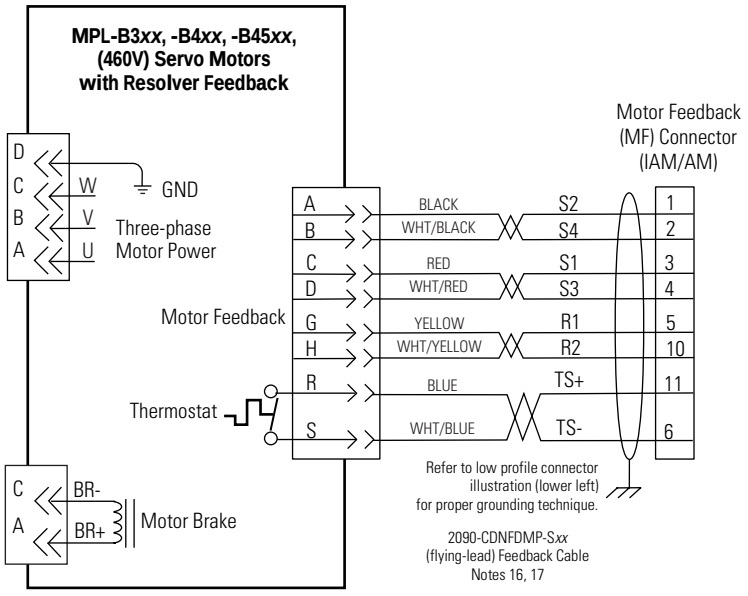


Axis Module/Motor Wiring Examples

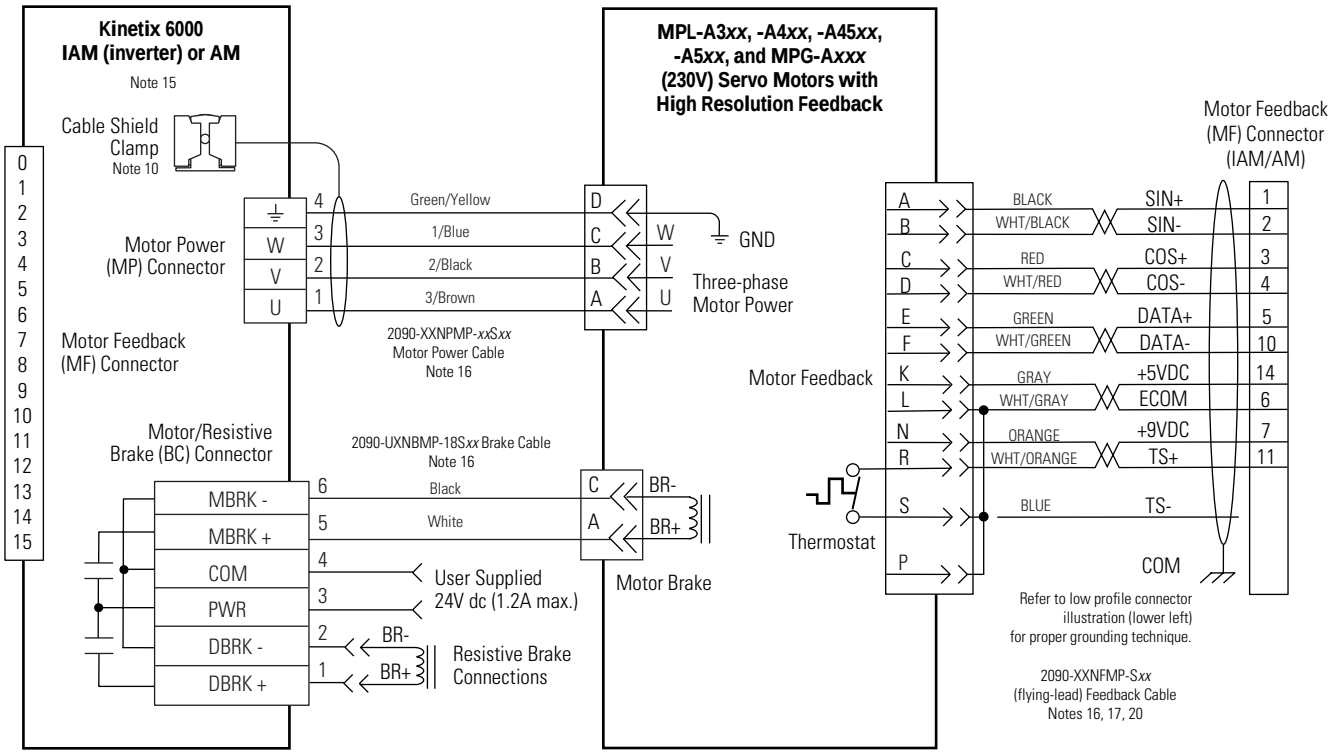
AM (460V) Wiring Example with MP-Series (MPL-B and MPG-B) Motors

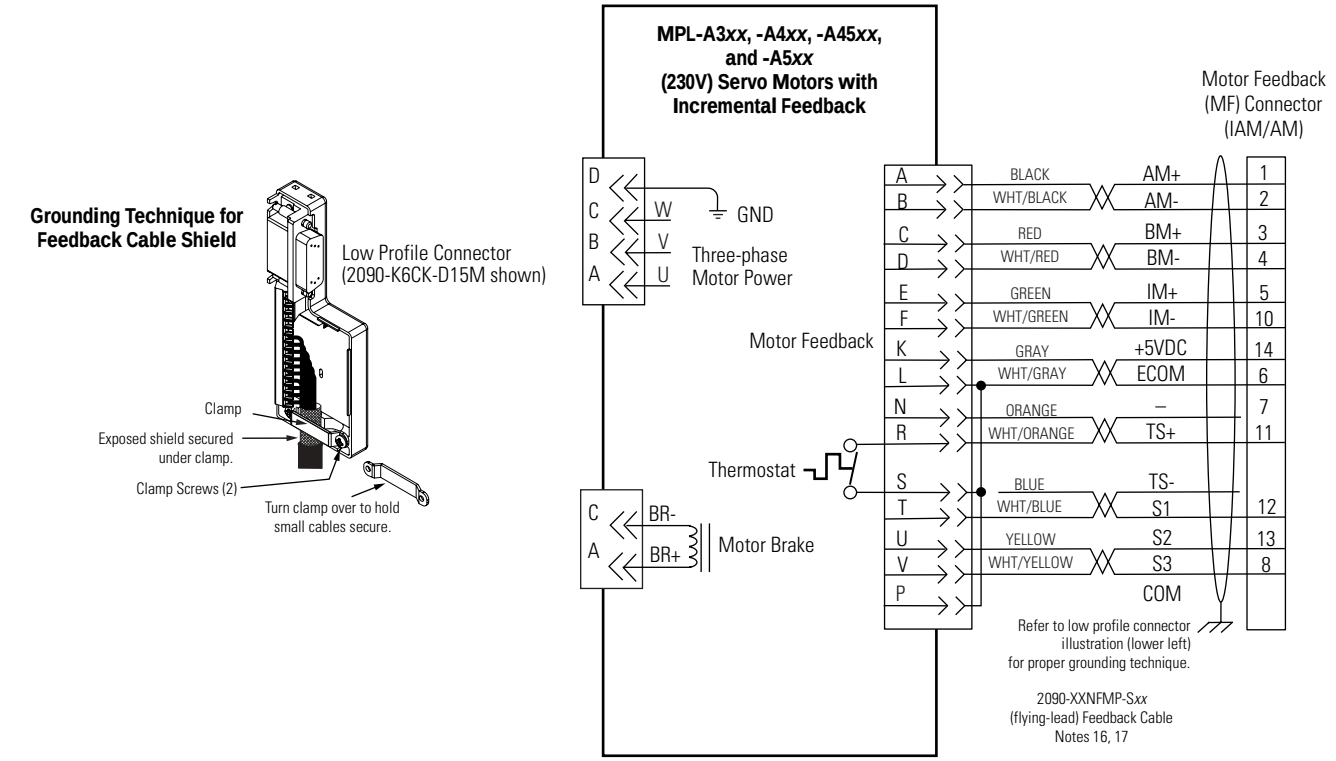




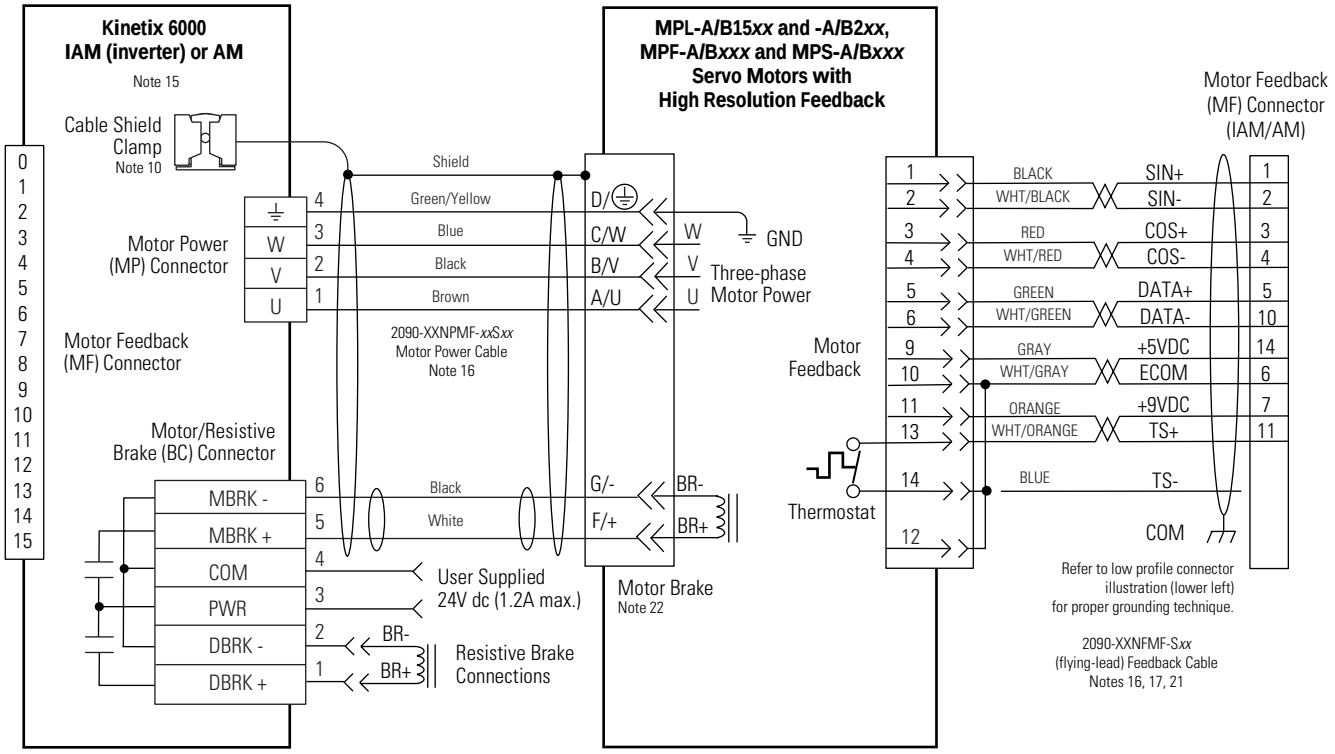


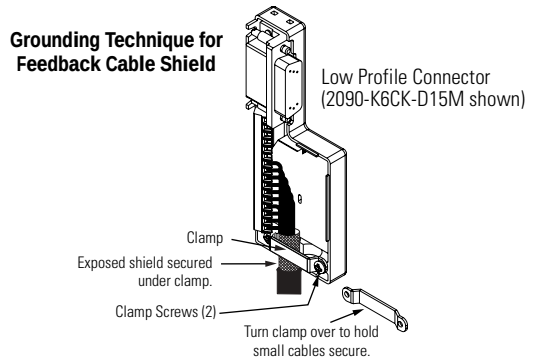
AM (230V) Wiring Example with MP-Series (MPL-A and MPG-A) Motors

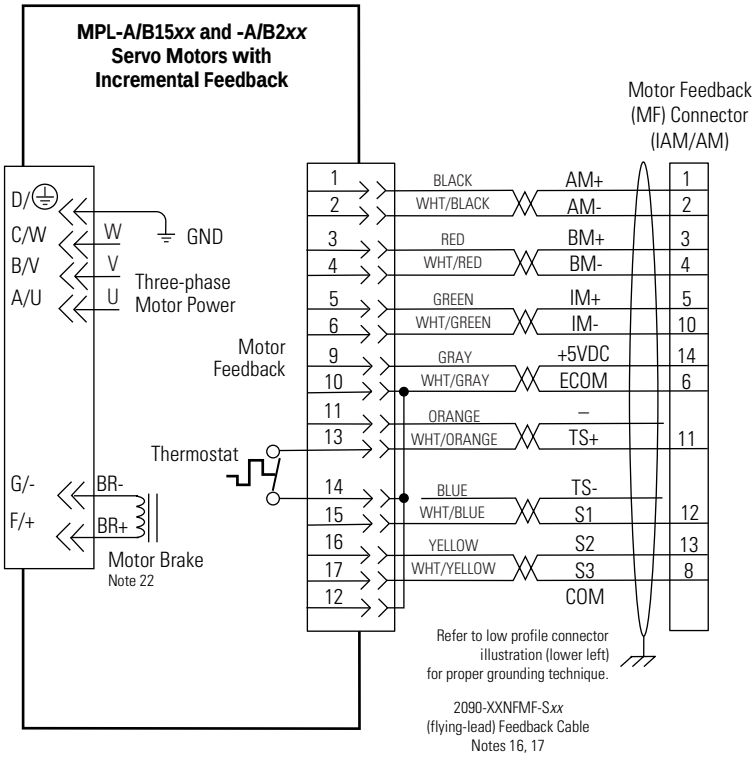




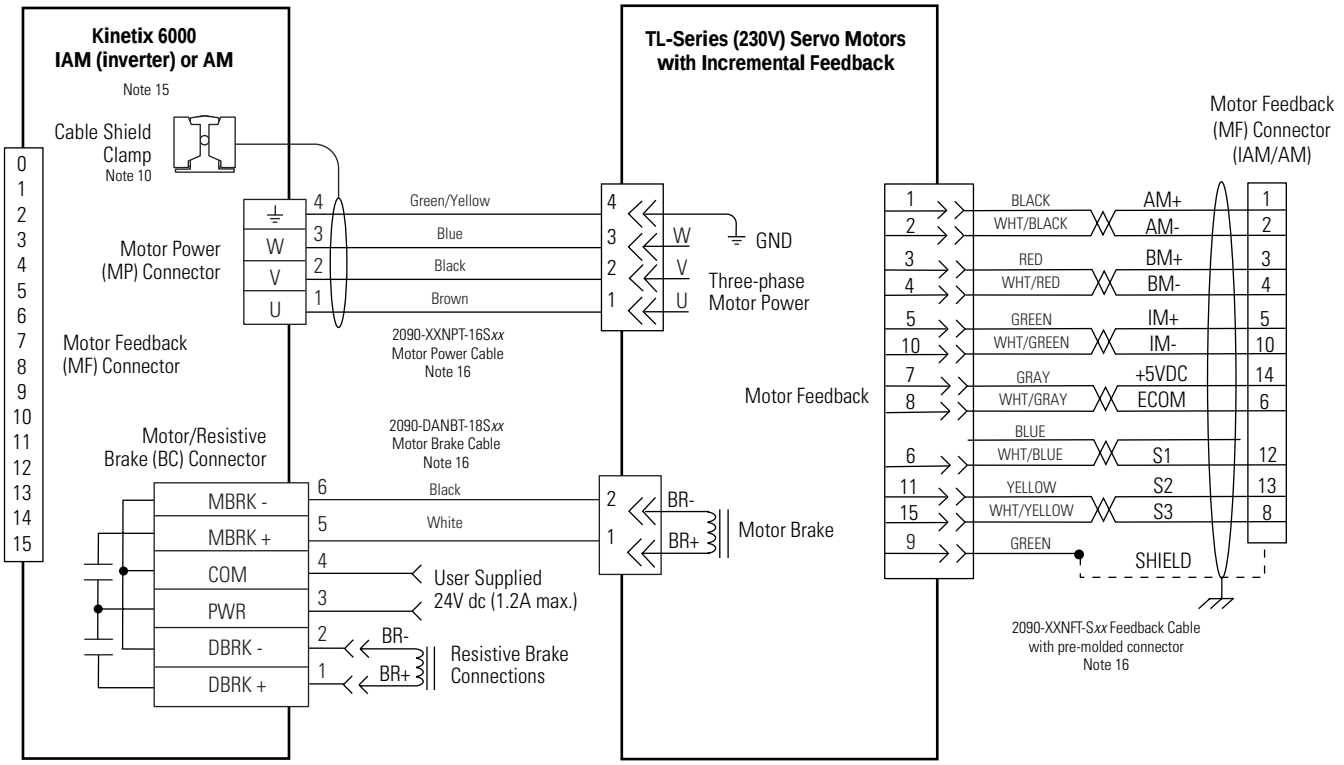
AM Wiring Example with MP-Series (MPL-A/B, MPF-A/B, and MPS-A/B) Motors



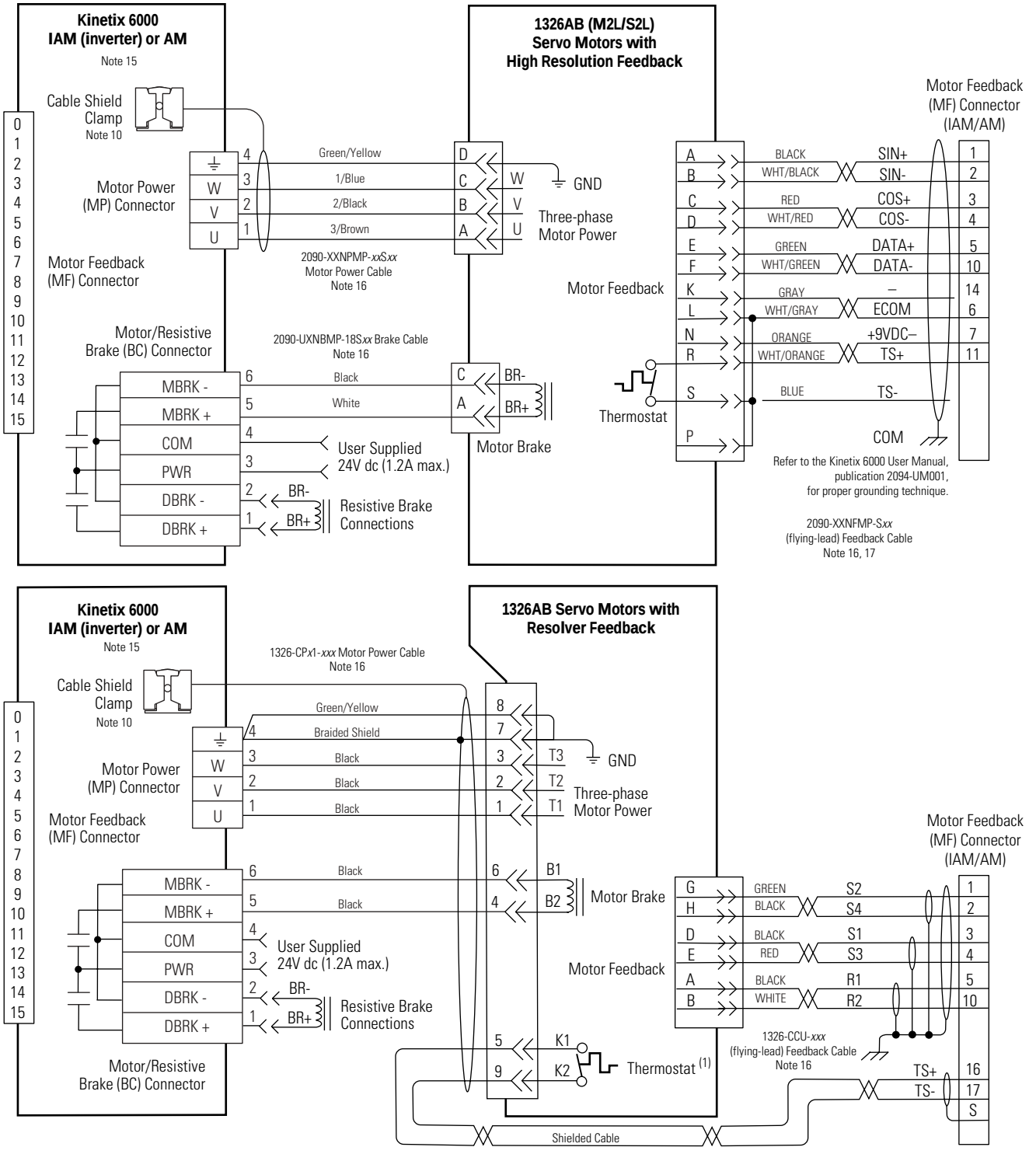




AM (230V) Wiring Example with TL-Series Motors

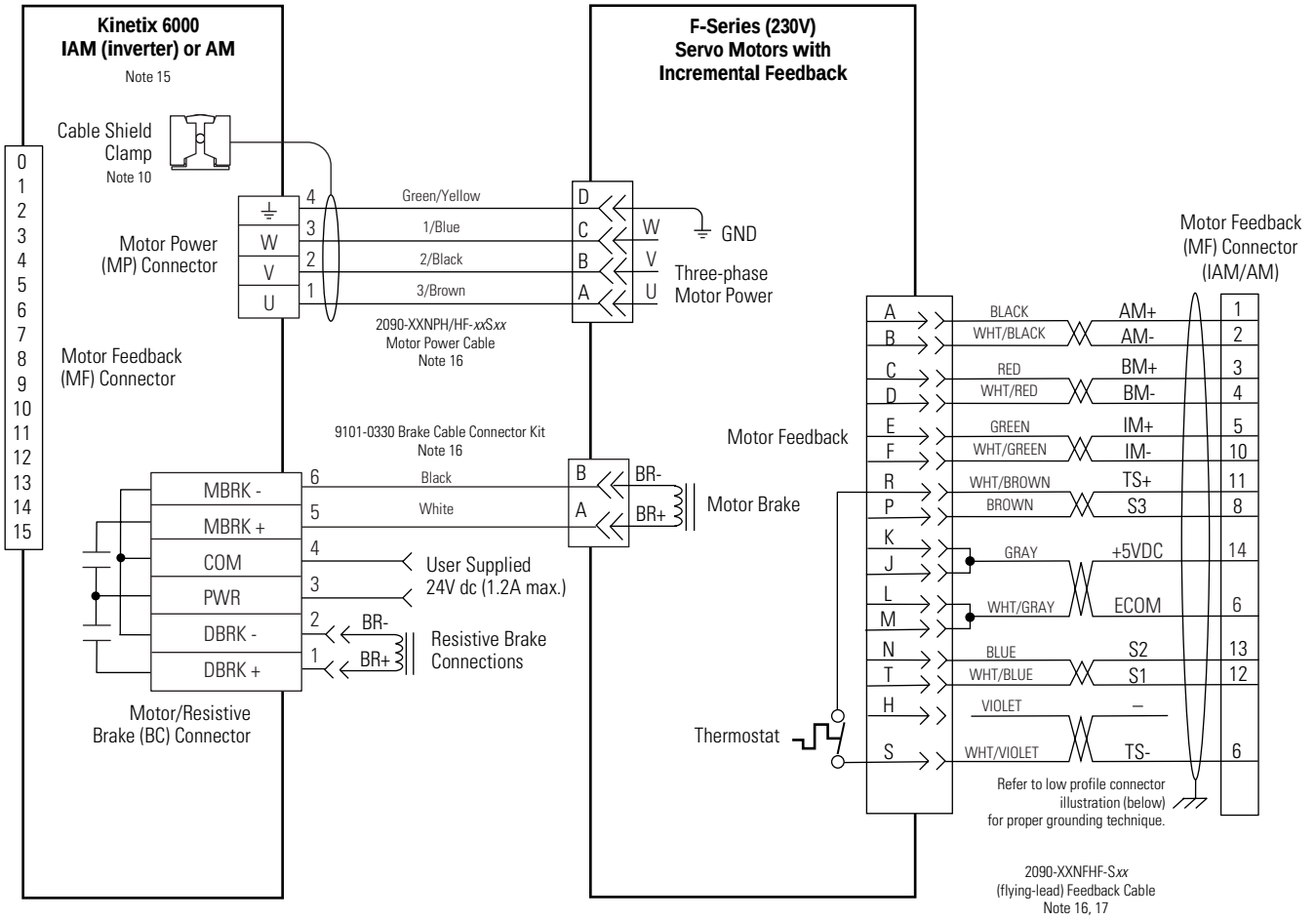


AM (460V) Wiring Example with 1326AB Motors

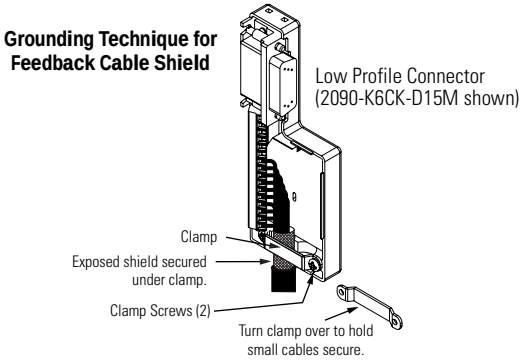


(1) Wiring the thermal switch on 1326AB (resolver-based) motors requires the use of the Low Profile connector kit (2090-K6CK-D15MF) and wire extension to the power connector. Pins 16, 17, and S are filtered to prevent noise transmission back to the drive. Refer to the Kinetix 6000 User Manual, publication 2094-UM001, for wiring instructions and a diagram.

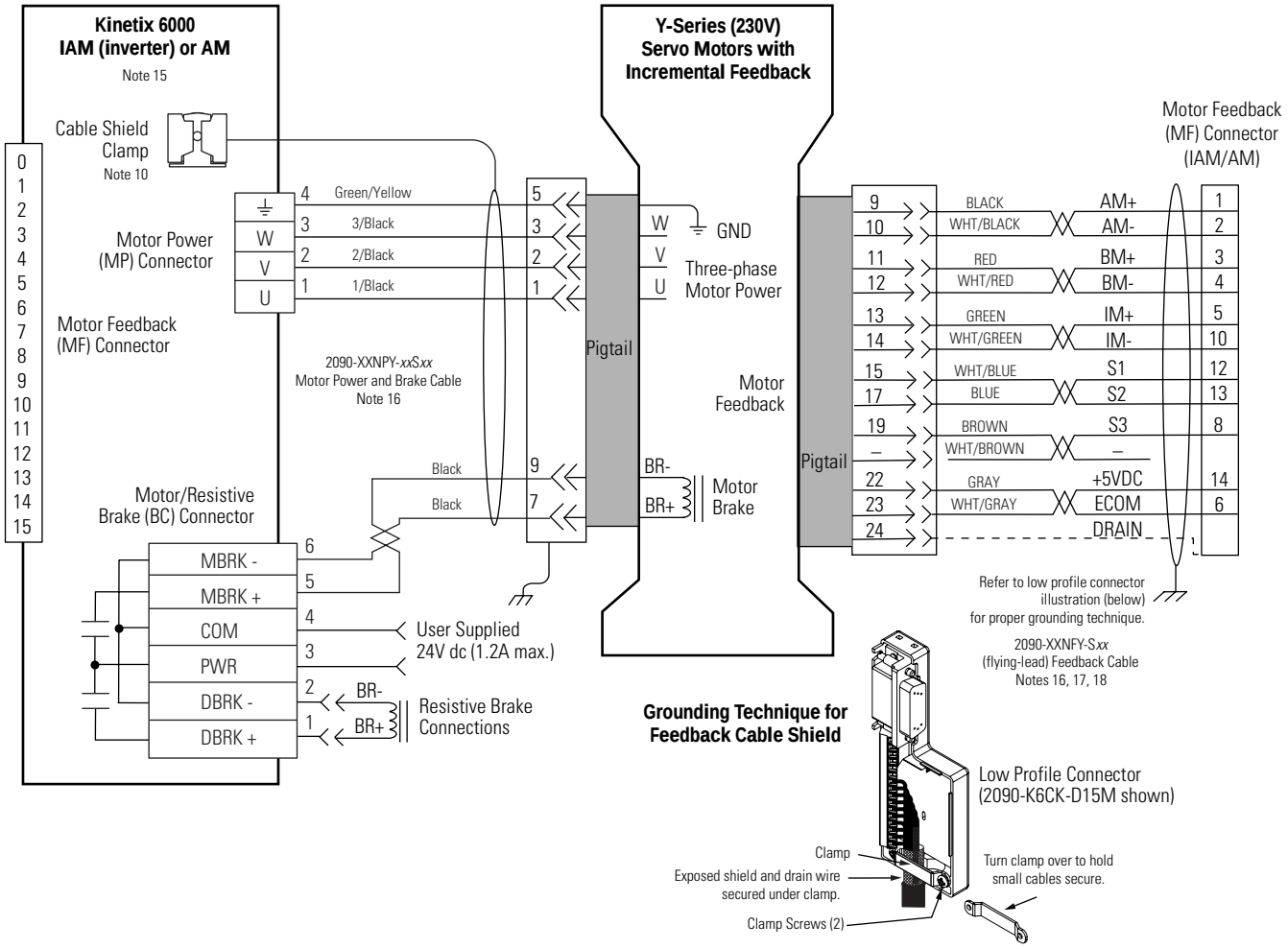
AM (230V) Wiring Example with F-Series Motors



Grounding Technique for Feedback Cable Shield



AM (230V) Wiring Example with Y-Series Motors



Controlling a Brake Example

The relay output of the Kinetix 6000 drive (MBRK± BC-5 and -6) is suitable for directly controlling a motor brake, subject to the relay voltage limit of 30V dc, and the relay current limit as shown in the table below.

Brake Relay Current Limit

Kinetix 6000 IAM/AM	Brake Current Rating, Max
2094-AC05-M*xx*, -AC09-M*xx*, 2094-AMP5, -AM01, -AM02	1.0 A
2094-BC01-M*xx*, -BC02-M*xx*, 2094-BMP5, -BM01, -BM02	
2094-AC16-M*xx*, -AC32-M*xx*, 2094-AM03, -AM05	1.3 A
2094-BC04-M*xx*, -BC07-M*xx*, 2094-BM03, -BM05	3.0 A

IMPORTANT For brake requirements outside of these limits, an external relay must be used.

Coil Currents Rated at < 1.0 A

Compatible Brake Motors	Coil Current
MPL-*x*15*xx* (1)	0.48 A
MPL-*x*2*xx* (1)	0.51 A
MPL/MPF/MPS-*x*310, -*x*320, -*x*330 (1)	0.50 A
MPL-*x*420, -*x*430, -*x*4520, -*x*4530, -*x*4540 (1)	0.64 A
MPF-*x*430, -*x*4530, -*x*4540 (1)	
MPG-*x*004 (1)	0.33 A
MPG-*x*010 (1)	0.45 A
MPG-*x*025 (1)	
MPG-*x*050 (1)	0.50 A
MPG-*x*110 (1)	1.0 A

Compatible Brake Motors	Coil Current
1326AB-B4*xxx*	0.88 A
F-4030, -4050, and -4075	0.69 A
Y-1002 and -1003	0.26 A
Y-2006 and -2012	0.31 A
Y-3023	0.37 A
TL-A110P-H, -A120P-H, and -A130P-H	0.208 A
TL-A220P-H and -A230P-H	0.375 A
TL-A2530P-H and -A2540P-H	0.396 A
TL-A410P-H	0.746 A

(1) Applies to 230V and 460V motors.

Coil Currents Rated at >1.0 A and ≤1.3 A

Compatible Brake Motors	Coil Current
F-6100, -6200, and -6300	1.30 A
H-6100, -6200, and -6300	1.13 A

Compatible Brake Motors	Coil Current
MPL-*x*520, -*x*540, -*x*560, -*x*580 (1)	1.05...1.28 A
MPF-B540	
1326AB-B5*xxx*, and -B7*xxx*	1.20 A

(1) Applies to 230V and 460V motors.

Coil Currents Rated at >1.3 A and ≤3.0 A

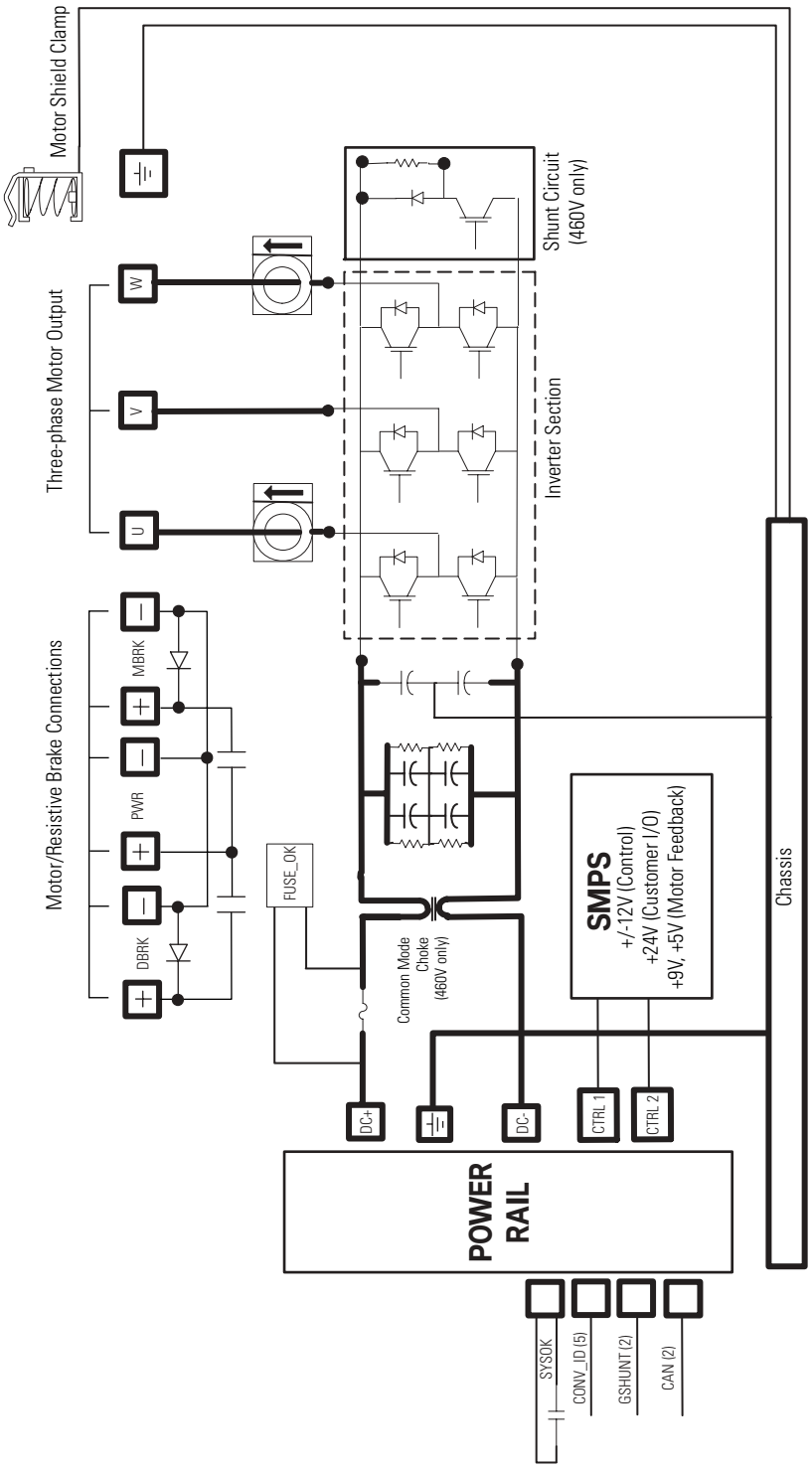
Compatible Brake Motors	Coil Current
H-8350 and -8500	2.20 A

Compatible Brake Motors	Coil Current
MPL-B640, -B660, -B680, -B860, -B880, -B960, -B980	1.91...2.19 A

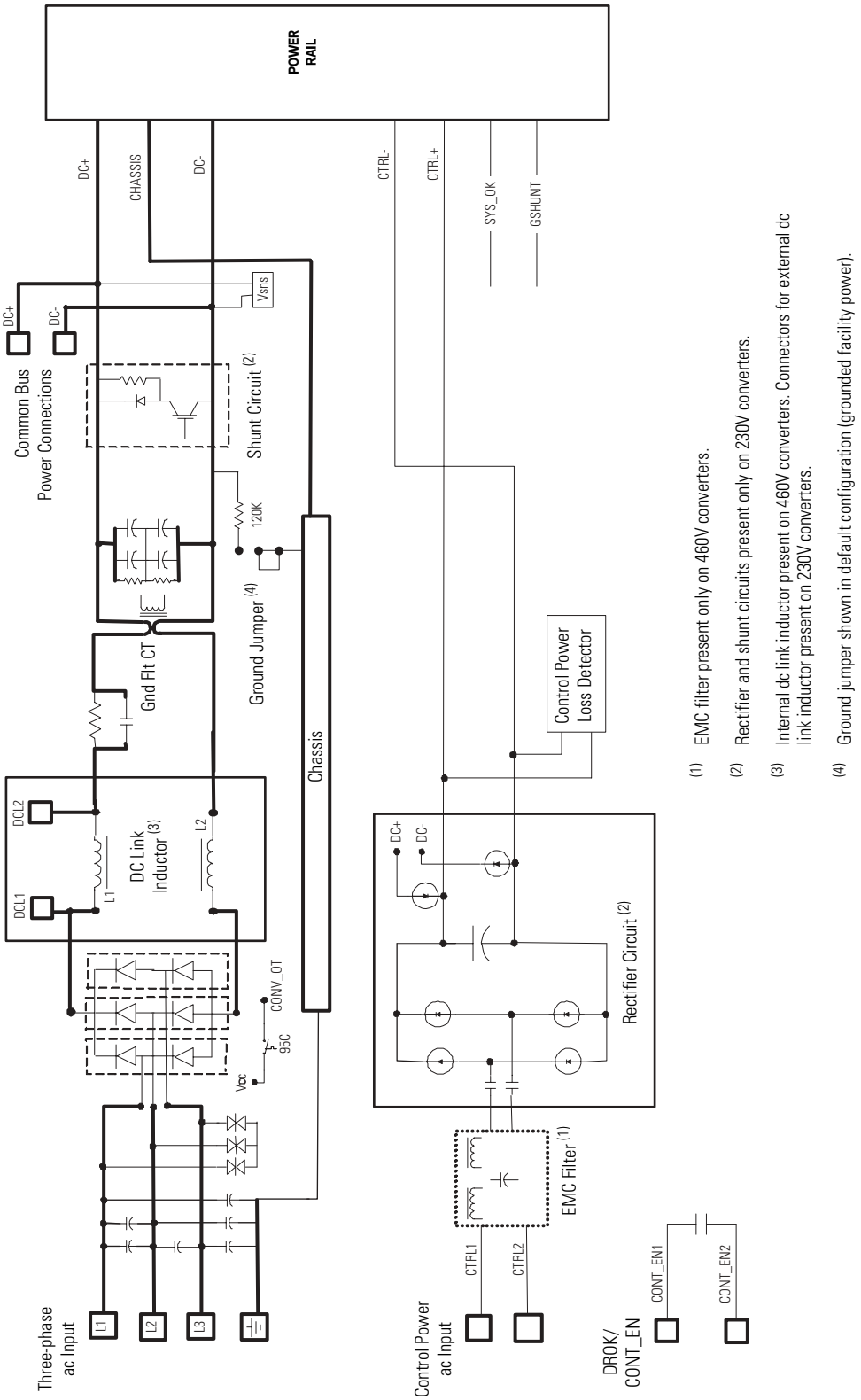
System Block Diagrams

This section provides block diagrams of the Kinetix 6000 modules. For block diagrams of the line interface module (LIM) and resistive brake module (RBM), refer to Additional Resources on page 10 for the documentation available for those products.

IAM/AM (inverter) Block Diagram



IAM (converter) Block Diagram



(1) EMC filter present only on 460V converters.

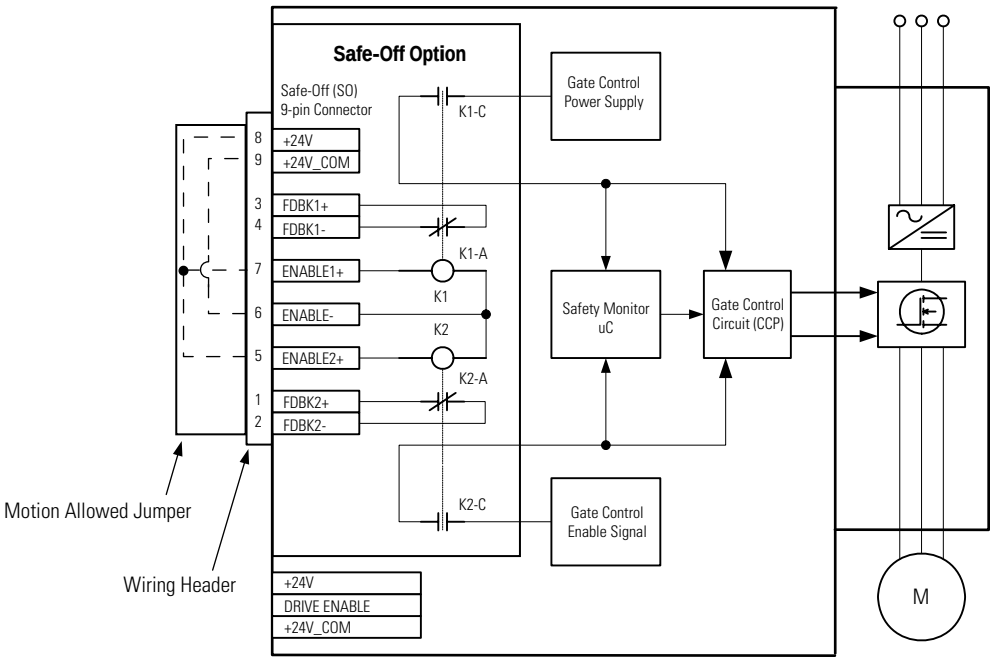
(2) Rectifier and shunt circuits present only on 230V converters.

(3) Internal dc link inductor present on 460V converters. Connectors for external dc link inductor present on 230V converters.

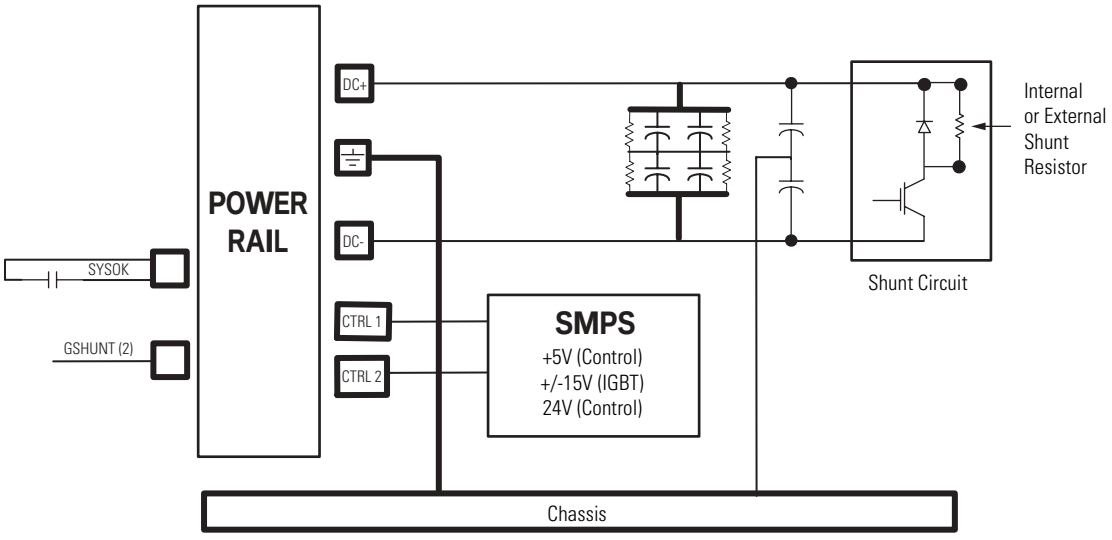
(4) Ground jumper shown in default configuration (grounded facility power).

Kinetix 6000 drives with the safe-off feature ships with the wiring header and motion allowed jumper installed. In this configuration, as illustrated below, the safe-off feature is not used.

Safe-off Feature Block Diagram



Shunt Module Block Diagram



Upgrading Firmware

Introduction

This appendix provides procedures for upgrading firmware using either ControlFLASH or DriveExplorer software.

Using ControlFLASH Software to Upgrade Drive Firmware

Upgrading axis module firmware using ControlFLASH software involves selecting the drive to flash, configuring your Logix communications, and flashing the firmware.

Before You Begin

You will need the following software and information before you begin.

Description	Catalog Number	Firmware Revision
RSLogix 5000 software	9324-RLD300NE	15.*x* or later
ControlLogix SERCOS module software	1756-M*xx*SE	15.32 or later
	1756-L60M03SE	15.4 or later
CompactLogix SERCOS module software	1768-M04SE	15.35 or later
SoftLogix SERCOS PCI card software	1784-PM16SE	15.33 or later
RSLinx software		2.50 or later
ControlFLASH software kit [1]		4.00.09 or later
Catalog number of the targeted Kinetix 6000 IAM/AM you want to flash		
Network path to the targeted Kinetix 6000 IAM/AM		

[1] Download the ControlFLASH kit from http://support.rockwellautomation.com/controlflash. Contact Rockwell Automation Technical Support at (440) 646-5800 for assistance.

For more ControlFLASH information (not drive specific), refer to the ControlFLASH Firmware Upgrade Kit User Manual, publication 1756-6.5.6.

IMPORTANT Control power (24V dc) must be present at CPD-1 and -2 prior to flashing your drive.

The seven-segment LED on the IAM (inverter) or AM to upgrade must be displaying a fixed 2, 3, or 4 before beginning this procedure.

ATTENTION To avoid personal injury or damage to equipment during the firmware upgrade due to unpredictable motor activity, do not apply three-phase ac or common bus dc input power to the drive.

The ControlFLASH utility software can be accessed by either of these methods.

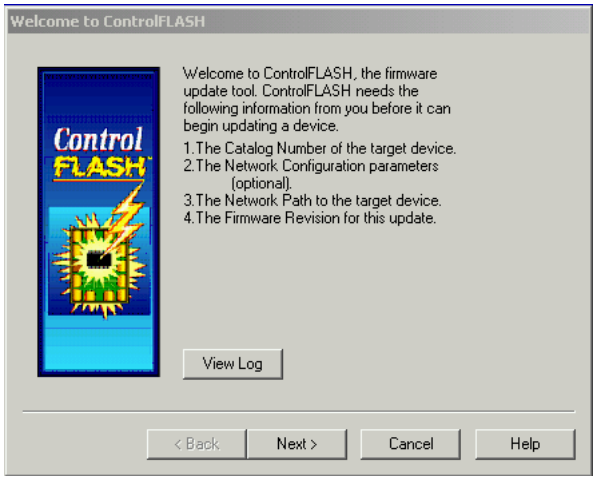
- Select ControlFLASH from the Tools menu in your RSLogx 5000 software.
- Select ControlFLASH from the Windows Start button/Program Files/Flash Tools.

Selecting the Drive to Upgrade

Follow these steps to upgrade (flash) your drive firmware.

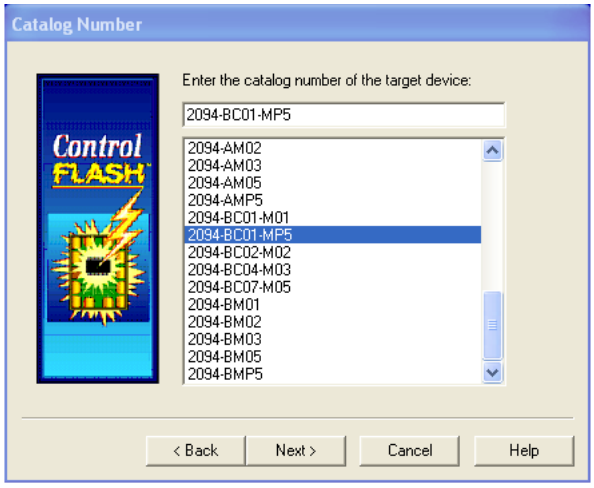
1. Open your ControlFLASH software.

   The Welcome to ControlFLASH dialog opens.



2. Click Next.

   The Catalog Number dialog opens.



3. Select the catalog number of your drive module to flash.

4. Click Next.

5. Minimize the RSLogix 5000 project dialog.

Configuring Logix Communications

This procedure assumes that your communication method to the Logix controller is using the Ethernet protocol. It is also assumed that your Logix Ethernet module has already been configured.

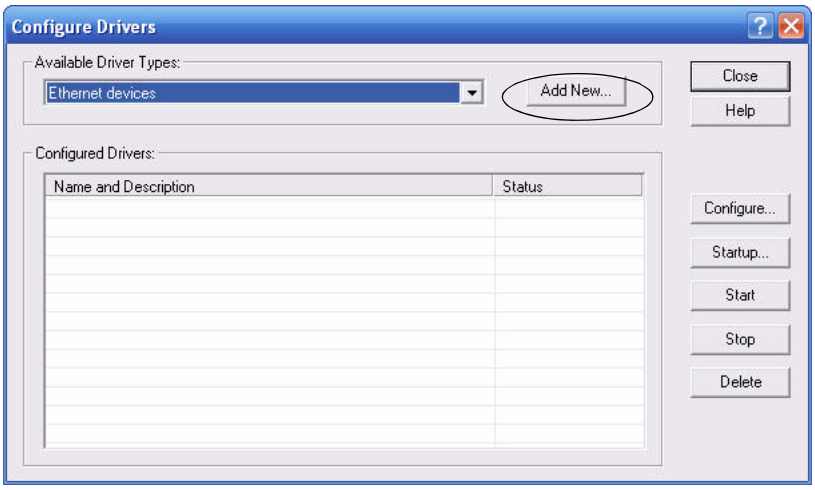
For more information, refer to the ControlLogix System User Manual, publication 1756-UM001.

Follow these steps to configure Logix communications.

1. Open the RSLinx Classic software and select Configure Drivers from the Communications menu.

   The Configure Drivers dialog opens.

2. Select Ethernet devices from the Available Driver Types menu.



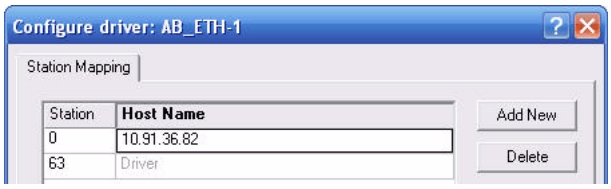
3. Click the Add New button.

   The Add New RSLinx Classic Driver dialog opens.

4. Name the new driver.

5. Click OK.

The Configure driver dialog opens.



6. Enter the IP address of your Logix ethernet module.

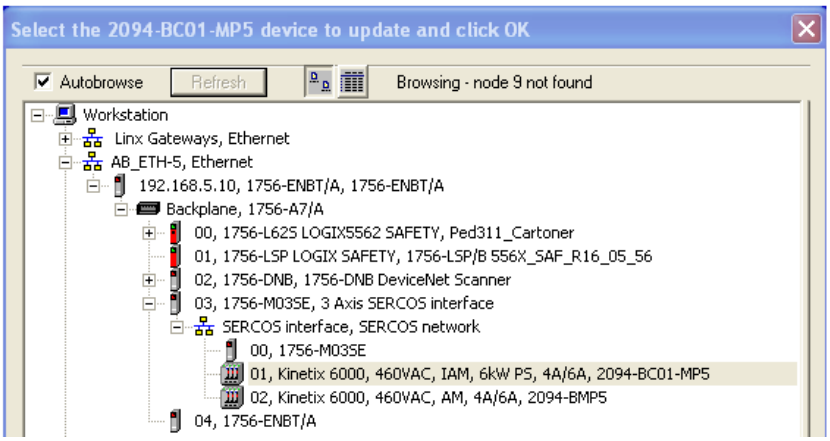
   The IP address shown is an example. Yours will be different.

7. Click OK.

8. Click Close in the Configure Drivers dialog.

9. Select RSWho from the Communication menu.

   The drive selection dialog opens.



10. Locate your servo drive by expanding the ethernet node, Logix backplane, and SERCOS interface module.

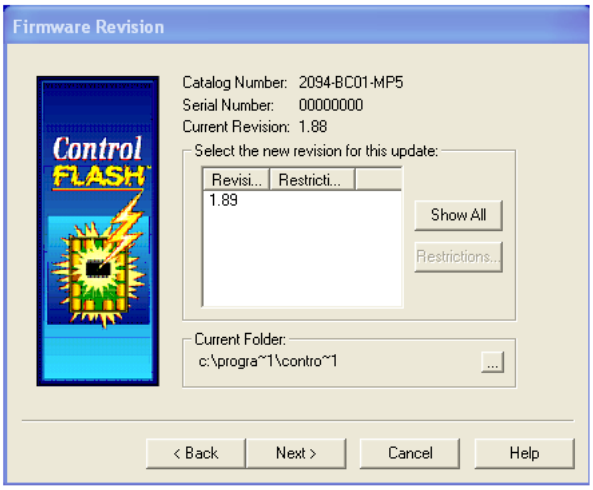
11. Select the servo drive to flash.

12. Click OK.

13. Minimize the RSLinx application dialog and return to your RSLogix 5000 project dialog.

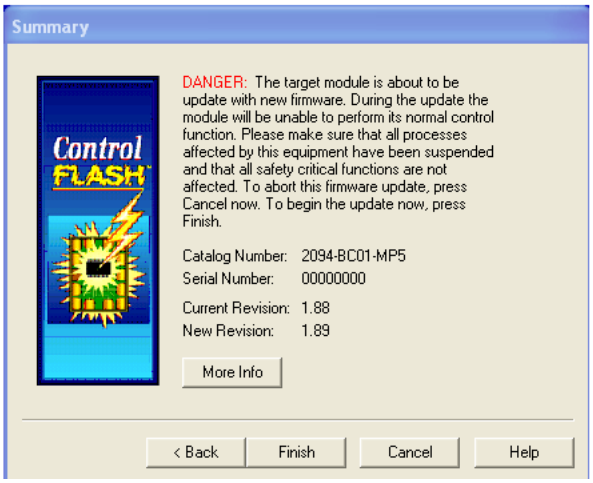
Flashing Firmware

The Firmware Revision dialog opens with the current firmware revision listed.



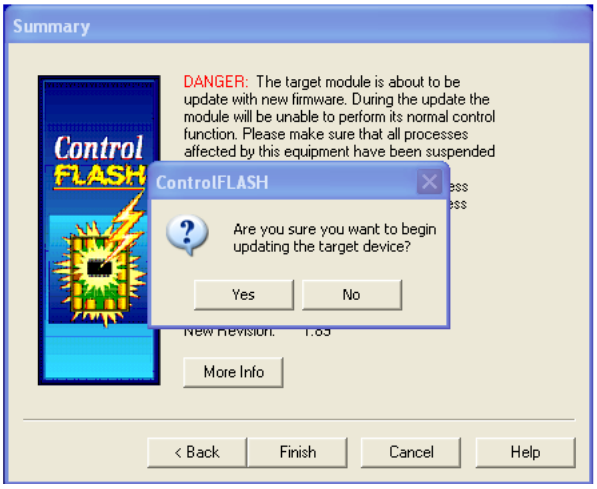
1. Select the firmware revision for the upgrade.
2. Click Next.

   The Summary dialog opens.



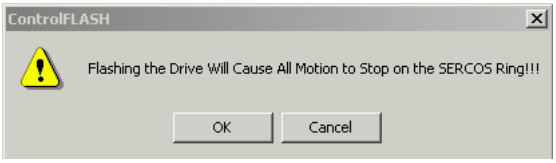
3. Confirm the drive catalog number and firmware revision.

4. Click Finish. This ControlFLASH warning dialog opens.



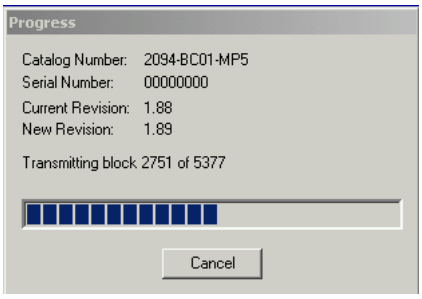
5. Click Yes (only if you are ready).

   This ControlFLASH warning dialog opens.



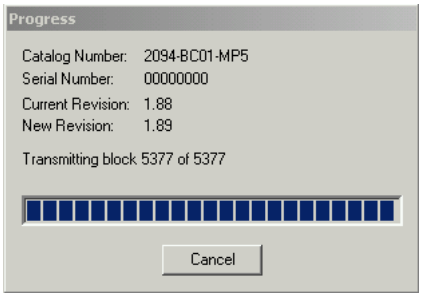
6. Acknowledge the warning and click OK.

   The Progress dialog opens and flashing begins.



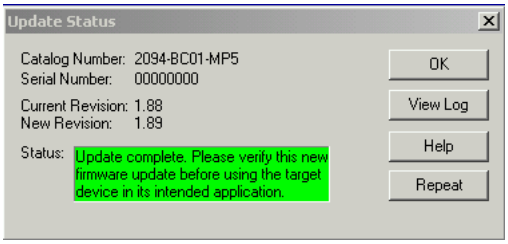
   The drive module seven-segment LED indicator changes from the fixed 2, 3, or 4 to F which indicates that flashing is in progress.

   After the flash information is sent to the drive, the drive resets and performs diagnostic checking.



7. The Update Status dialog opens and indicates success or failure as described below.

Flashing	If
Succeeded	1. Update complete appears in a GREEN status dialog. 2. Go to Step 8.
Failed	1. Update failure appears in a RED status dialog. 2. Go to Troubleshooting ControlFLASH.



8. Select OK.

   The ControlFLASH software returns to the Welcome screen where you can flash another drive or select Cancel to exit the program.

Troubleshooting ControlFLASH

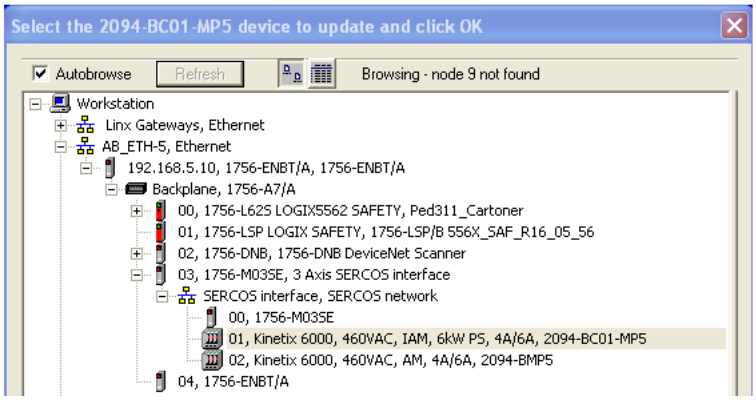
If your Update Status dialog in Step 7 indicated failure, check the following items and begin the process again at Step 1:

- Control (24V) power lost at drive.
- SERCOS ring is down (seven-segment LED no longer displays fixed 2, 3, or 4).
- Logix chassis lost power.
- Bad flashdata checksum.

Verifying the Firmware Upgrade

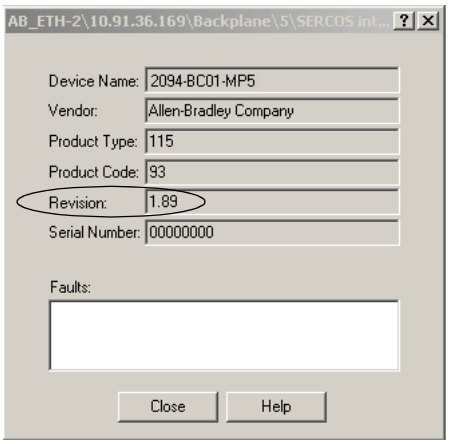
Follow these steps to verify your firmware upgrade was successful. This procedure is optional.

1. Return to the RSLinx Classic software and expand the dialog tree to gain access to your drive module, as you did earlier.



2. Right-click the drive module and select Drive Properties.

   The Drive Properties dialog opens.



3. Verify the new firmware revision level.

4. Click Close.

Using DriveExplorer Software to Upgrade Drive Firmware

Upgrading axis module firmware using DriveExplorer involves setting the Axes to Flash parameter, configuring a HyperTerminal session, and flashing the firmware.

Before You Begin

You will need the following software and information before you begin.

Description	Catalog Numbers	Firmware Revision
DriveExplorer Software [1]	9306-4EXP02ENE	2.01 or later
Serial to SCANport Adapter	1203-SSS (Series B)	3.004 or later
RSLogix 5000 Software	9324-RLD300NE	11.0 or later
Firmware upgrade file for your Kinetix 6000 drive (IAM/AM) [2]		
Personal computer with HyperTerminal software		

[1] Refer to DriveExplorer Getting Results Manual, publication 9306-GR001, for instructions.
[2] Contact Rockwell Automation Technical Support at (440) 646-5800 for firmware upgrade file.

IMPORTANT Control power (24V dc) must be present at CPD-1 and -2 prior to flashing your drive.

ATTENTION

To avoid personal injury or damage to equipment during the firmware upgrade due to unpredictable motor activity, do not apply three-phase ac or common bus dc input power to the drive. Do not establish communications with the Logix SERCOS interface module.

Selecting Axis Modules to Upgrade

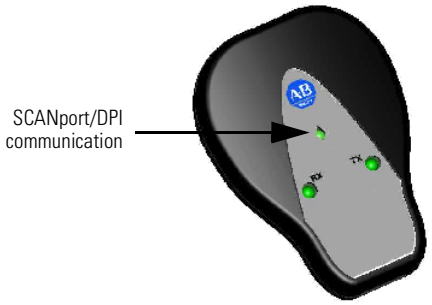
In this procedure you will use DriveExplorer software to set the Axes to Flash parameter (*x*708) and select the axis module to upgrade.

TIP You will save time by selecting only the axis modules that require a firmware upgrade.

Follow these steps to set the Axes to Flash parameter.

1. Connect the 1203-SSS serial cable to the appropriate COM port on your personal computer.
2. Connect the 1203-SSS SCANport cable to the SCANport/DPI connector on your IAM.

3. Verify that the 1203-SSS has power by observing the LED indicated in the figure below.

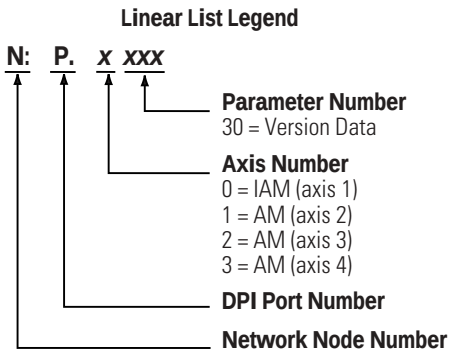


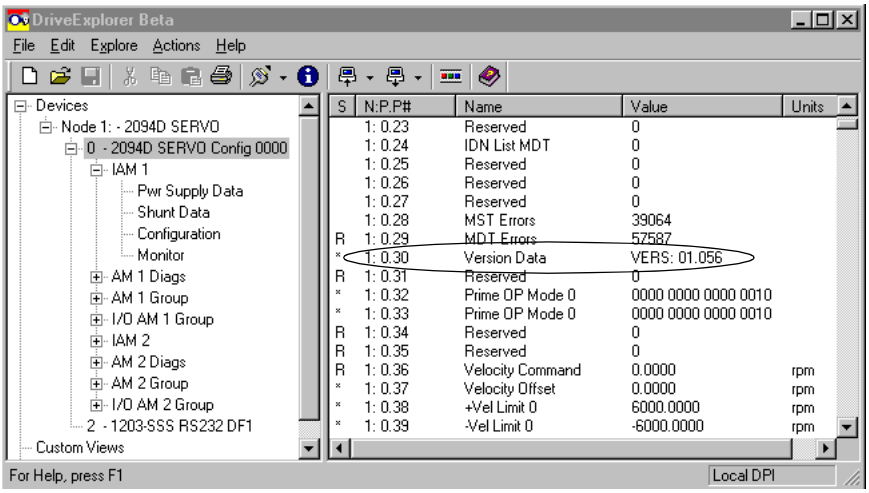
4. Open the DriveExplorer software and select Connect from the Explore menu.

   The DriveExplorer software proceeds to read your system.

5. Double-click 2094D SERVO Config 0000.

   The linear list of parameters dialog appears.

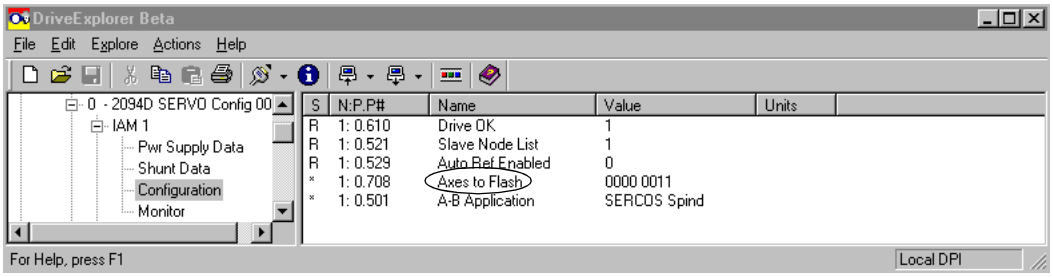




6. Scroll down to parameter *x:x.*30 (Version Data) and record the version (VERS: *xx.xxx*) of each axis module.

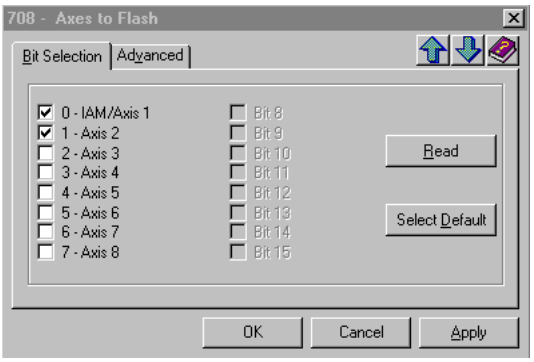
7. Double-click Configuration.

   The following dialog opens.



8. Double-click Axes to Flash.

   The Axis to Flash dialog opens.



9. Click (check) each axis to flash.

   Example above shows two axes to flash checked.

10. Select OK.

    The Axes to Flash parameter is set.

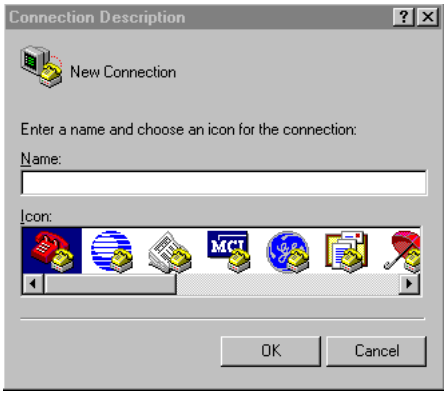
11. Close DriveExplorer.

HyperTerminal Configuration

Follow these steps to begin a new HyperTerminal session.

1. From the Windows Start menu, select Programs\Accessories\HyperTerminal\HyperTerminal.

   The New Connection dialog opens.



2. Type a name the new HyperTerminal file and choose an icon for the connection.

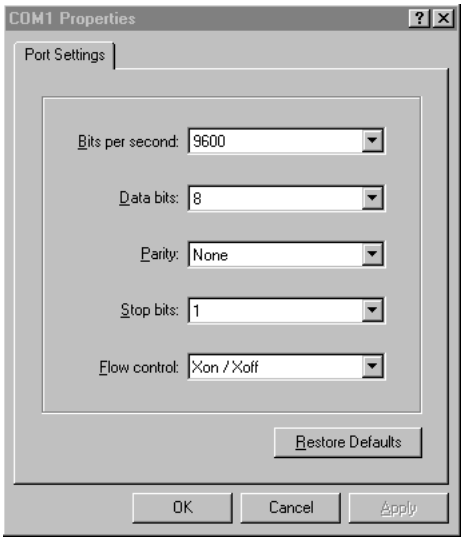
3. Select OK.

   The following dialog opens.

4. Select the appropriate COM port.

5. Select OK.

   The following dialog opens.



6. Select the properties as shown above or as appropriate for your 1203-SSS SCANport adapter.

IMPORTANT Bits per second of HyperTerminal must match the 1203-SSS SCANport adapter setting for connection to occur.

7. Select OK.

8. HyperTerminal configuration is complete.

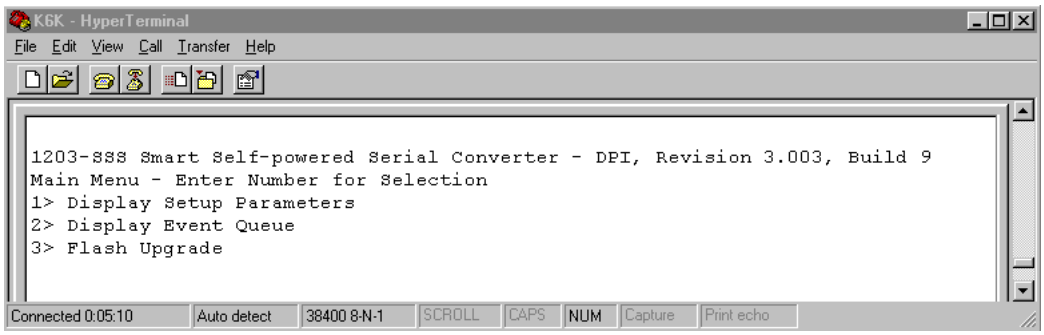
Flashing Firmware

This procedure assumes you have identified which axis modules require flashing, have set the Axes to Flash parameter, and have configured a HyperTerminal session.

IMPORTANT You must also know where to find your firmware upgrade file.

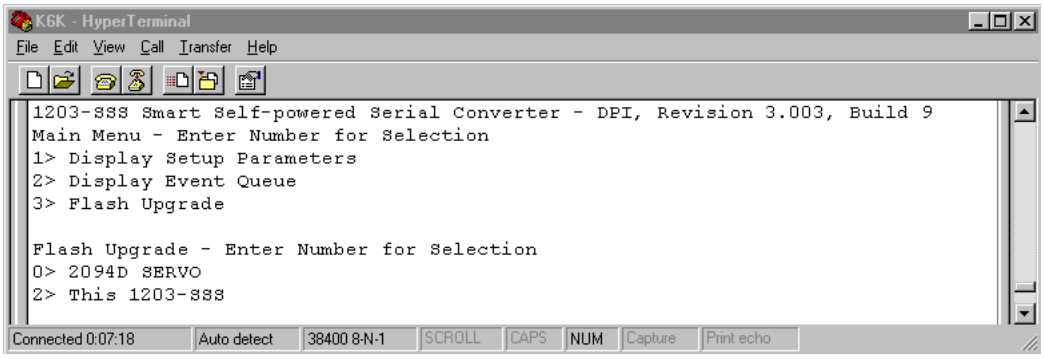
1. Press ENTER.

   The HyperTerminal main menu opens.



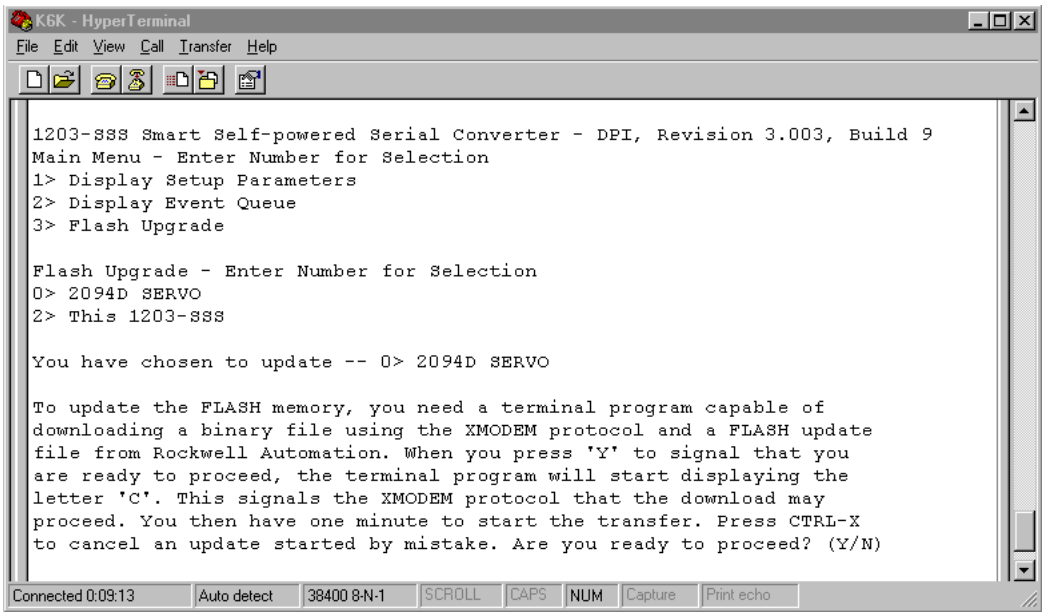
2. Enter 3.

   The following dialog opens.



3. Enter 0.

The following dialog opens.



4. Enter Y.

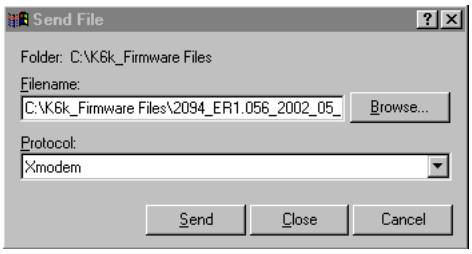
   As indicated in the text, the program begins displaying the character C.

   TIP Program times-out after 60 seconds. If program times-out before you complete steps 5...8, return to Step 1.

5. From the Transfer menu select Send File.

   The Send File dialog opens.

Firmware upgrade file, as provided by Rockwell Automation Technical Support at (440) 646-5800.

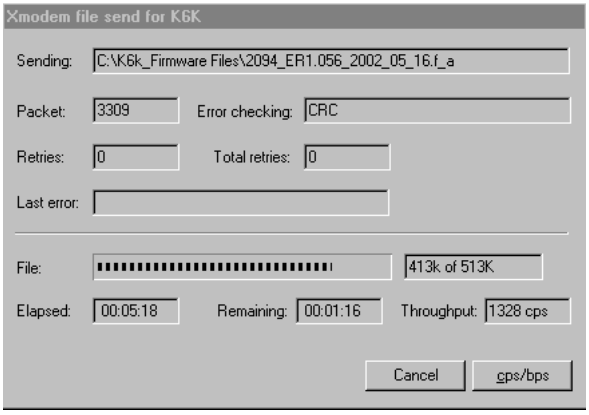


6. Browse for your firmware upgrade file.

7. Select Xmodem protocol.

8. Select Send.

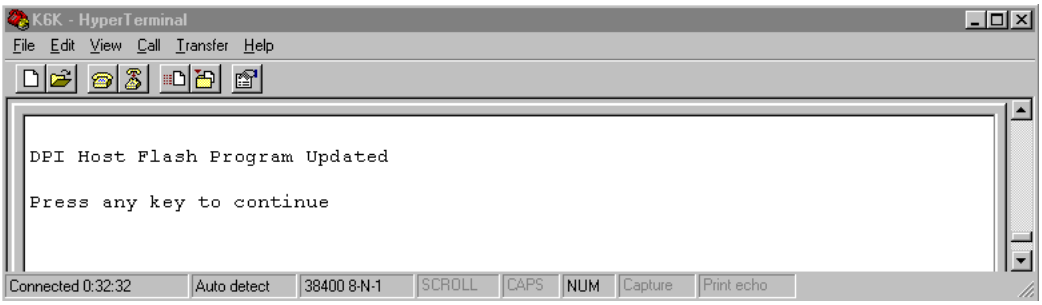
The flash upgrade operation begins and the following dialog opens.



ATTENTION

To avoid unrecoverable fault to drive modules, do not interrupt control power to IAM, power to the 1203-SSS SCANport adapter, or power to your PC while the flash upgrade operation is in progress.

The flash operation completes and the following dialog opens.



9. Close the HyperTerminal session.

10. Verify that parameter 30 for each axis module is now upgraded to the new firmware revision.

11. Return to DriveExplorer (refer to Selecting Axis Modules to Upgrade, Step 5) to see the linear list of parameters.

DC Common Bus Applications

Introduction

This appendix provides integration procedures specific to the Kinetix 6000 multi-axis servo-drive systems configured for dc common bus. The procedure involves calculating capacitance values and setting the Add Bus Cap parameter using DriveExplorer software.

Before You Begin

These procedures assume you have mounted and wired your Kinetix 6000 dc common bus system.

IMPORTANT Drive firmware v1.071 or later is required to use the RBM with the Kinetix 6000 drives.

Before you set the Additional Bus Capacitance (Add Bus Cap) parameter in DriveExplorer, you need to calculate the following values.

- Total bus capacitance
- Additional bus capacitance

Calculating Total Bus Capacitance

Total bus capacitance is the sum of all capacitance values for your Kinetix 6000 common bus modules. Specifically, this includes the capacitance values for each of these modules.

- Leader IAM (converter and inverter)
- Each AM and SM (if present) on the leader IAM power rail
- Each follower IAM (converter and inverter)
- Each AM on the follower IAM power rails

Refer to Kinetix 6000 Capacitance Values on page 233 for IAM/AM/SM capacitance values.

IMPORTANT When total bus capacitance exceeds the leader IAM maximum value, the IAM fault status LED indicator displays error code E90 (pre-charge time-out fault) and the drive is disabled.

Leader IAM (230V)	Maximum Bus Capacitance µF	Leader IAM (460V)	Maximum Bus Capacitance µF
2094-AC05-MP5-S	7145	2094-BC01-MP5-S	4585
2094-AC05-M01-S		2094-BC01-M01-S	
2094-AC09-M02-S	15,295	2094-BC02-M02-S	8955
2094-AC16-M03-S	34,400	2094-BC04-M03-S	8955
2094-AC32-M05-S	62,825	2094-BC07-M05-S	17,915

IMPORTANT If your total bus capacitance value exceeds the value in the table above, you must increase the size of the leader IAM or decrease the total bus capacitance by removing axis modules.

Calculating Additional Bus Capacitance

Additional bus capacitance is the sum of all follower IAM and AM capacitance values for your Kinetix 6000 common bus modules. Specifically, this includes the capacitance values for each of these modules.

- Each follower IAM (converter and inverter)
- Each AM on the follower IAM power rails

Enter the additional bus capacitance values in Step 6 of Setting the Additional Bus Capacitance Parameter.

Kinetix 6000 Capacitance Values

Use the tables below when calculating total bus capacitance and additional bus capacitance for your Kinetix 6000 common bus application.

IAM/AM (230V) Modules

IAM Converter (230V)	Capacitance µF
2094-AC05-MP5-S	270
2094-AC05-M01-S	
2094-AC09-M02-S	540
2094-AC16-M03-S	1320
2094-AC32-M05-S	1980

AM Inverter (230V)	Capacitance µF
2094-AMP5-S	390
2094-AM01-S	660
2094-AM02-S	780
2094-AM03-S	1320
2094-AM05-S	2640

IAM/AM (460V) Modules

IAM Converter (460V)	Capacitance µF
2094-BC01-MP5-S	110
2094-BC01-M01-S	
2094-BC02-M02-S	220
2094-BC04-M03-S	940
2094-BC07-M05-S	1410

AM Inverter (460V)	Capacitance µF
2094-BMP5-S	75
2094-BM01-S	150
2094-BM02-S	270
2094-BM03-S	840
2094-BM05-S	1175

SM (230/460V) Module

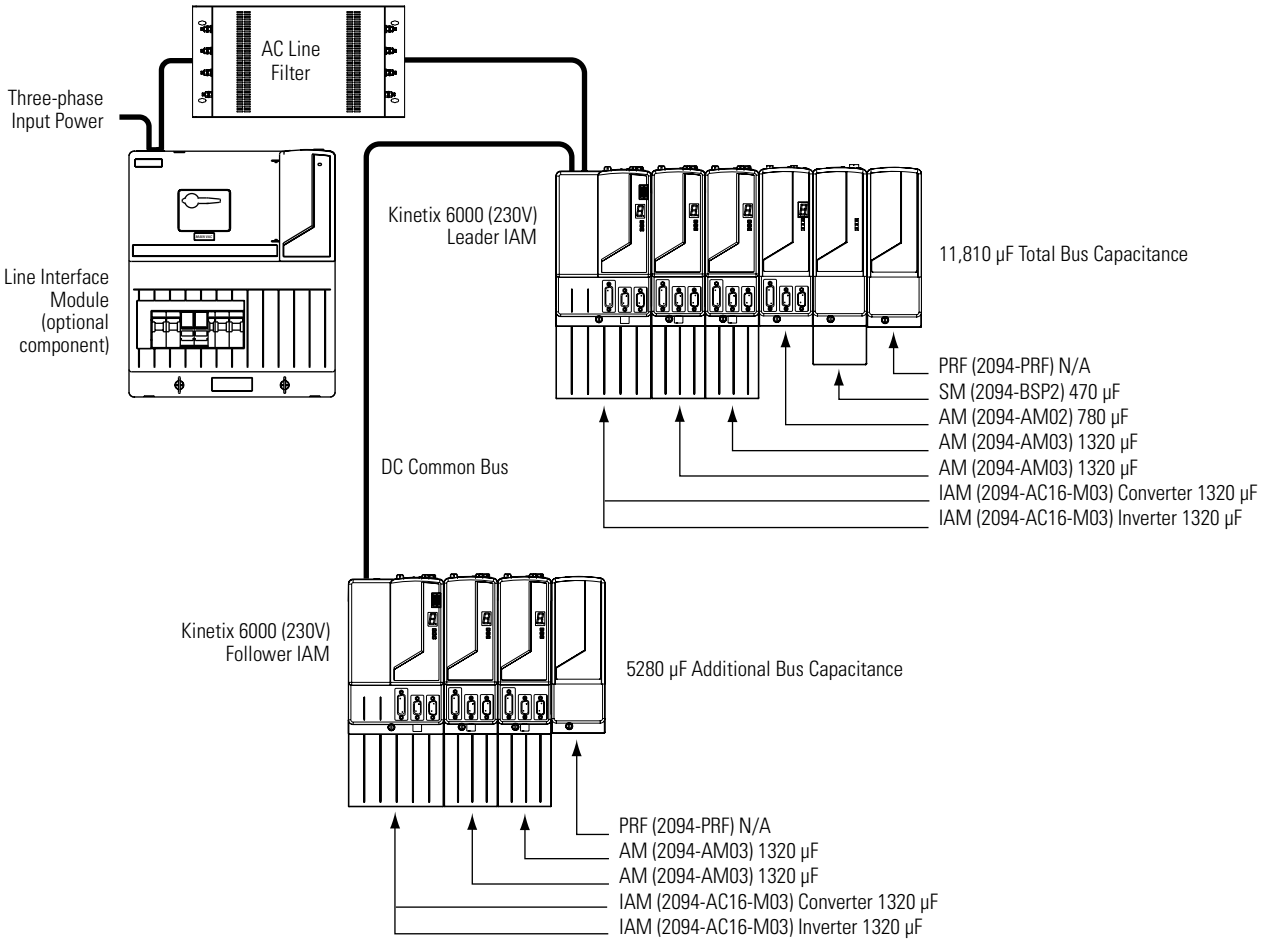
SM (230-460V)	Capacitance µF
2094-BSP2	470

Common Bus Capacitance Example

In the example below, the sum of the leader IAM power rail modules capacitance (6530 µF) and the follower IAM power rail modules capacitance (5280 µF) equals 11,810 µF total bus capacitance.

The sum of the follower IAM power rail modules equal 5280 µF additional bus capacitance.

Calculating Common Bus Capacitance



Setting the Additional Bus Capacitance Parameter

In this procedure you will set the Add Bus Cap parameter using DriveExplorer software.

The following hardware and software tools are required to provide the necessary communication link between your personal computer and the Kinetix 6000 drive system running DriveExplorer software.

Description	Catalog Numbers	Version
DriveExplorer Software (1) (2)	9306-4EXP02ENE	2.01 or later
Serial to SCANport Adapter (2) (3)	1203-SSS (Series B)	3.004 or later
RSLogix 5000 Software	9324-RLD300NE	15.0 or later

(1) Refer to DriveExplorer Getting Results Manual, publication 9306-GR001, for instructions.

(2) Additional information regarding these communication and software tools is available at http://www.ab.com/support/abdrives.

(3) Refer to 1203-SSS (Series B) FRN 3.*xxx* User Manual, publication 20COMM-UM001, for instructions.

ATTENTION

To avoid personal injury or equipment damage, at least one end of a SERCOS fiber-optic cable must be disconnected from the drive. This ensures that motion will not occur while changes are being made to the Add Bus Cap parameter.

Removing SERCOS Communication

Follow these steps to remove (break) SERCOS communications.

1. Remove three-phase and control power from the Kinetix 6000 drive system.
2. Remove one of the SERCOS fiber-optic cables.

   Fiber-optic cable connections (Tx and Rx) are located on the top of each IAM/AM.
3. Re-apply three-phase and control power.

Setting the Additional Bus Capacitance Parameter

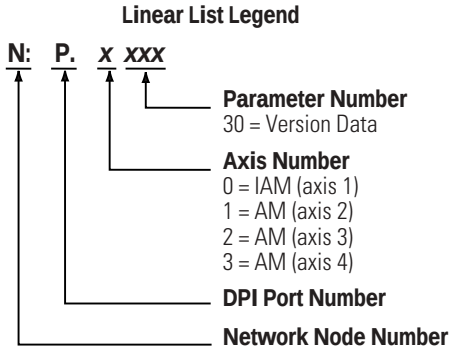
Follow these steps to set the Additional Bus Capacitance parameter.

1. Start your DriveExplorer software.

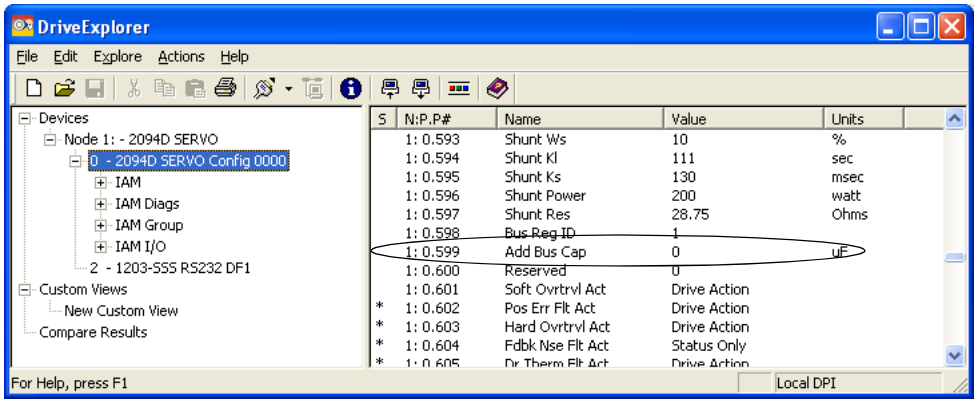
2. From the menu bar choose Explore\Connect\Local or enter Ctrl-L from the keyboard.

   DriveExplorer software will read your system.

3. Observe the Linear List of parameters as grouped by Node, Port, and Axis hierarchy as shown below.

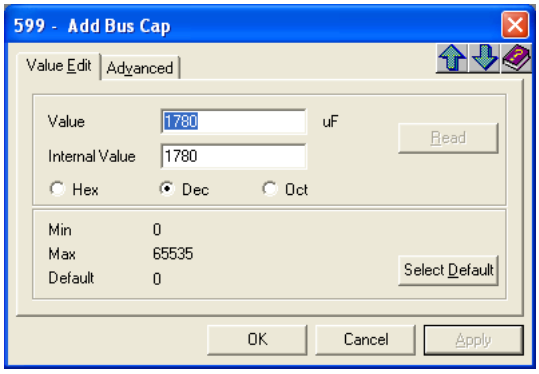


4. Select Devices\Node\Product\ and navigate to the parameter *x:x:x*599 as shown below.



5. Double-click the *x:x:x*599 Add Bus Cap parameter.

The command dialog for parameter *x*599 - Add Bus Cap opens.



6. Select the Value Edit tab and enter the Add Bus Cap Value (µF).

7. Click OK.

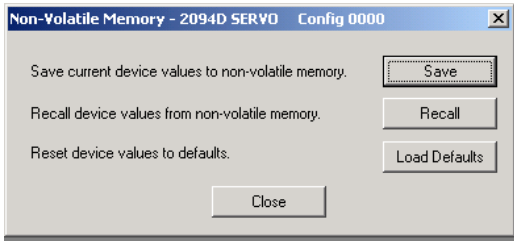
   The RBM delay time is changed, but not saved in non-volatile memory.

Saving the Add Bus Cap Parameter to Non-Volatile Memory

Follow these steps to save the Add Bus Cap parameter to non-volatile memory.

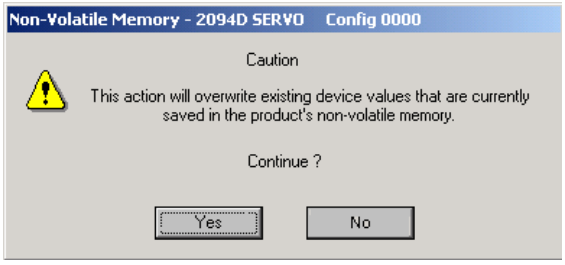
1. From the menu bar choose Actions\Non-Volatile Memory.

   The following message dialog opens.



2. Click Save.

   The changes are saved to non-volatile memory and the following cautionary message dialog opens.



3. Click Yes.

The save to non-volatile memory is complete and the following confirmation message dialog opens.

4. Click OK.

5. Close the DriveExplorer software.

Reconnecting SERCOS Communication

Follow these steps to reconnect SERCOS communication.

1. Remove three-phase and control power from the Kinetix 6000 drive system.

2. Replace the SERCOS fiber-optic cable removed earlier.

   Fiber-optic cable connections (Tx and Rx) are located on the top of each IAM/AM.

3. Re-apply three-phase and control power.

Integrating Resistive Brake Modules with Kinetix 6000 Drives

Introduction

This appendix provides Bulletin 2090 Resistive Brake Module (RBM) integration procedures and interconnect diagrams specific to Kinetix 6000 multi-axis servo-drive systems. The procedure involves setting the time delay parameter using either RSLogix 5000 or DriveExplorer software.

Before You Begin

These procedures assume you have mounted and wired your resistive brake module (RBM) with the Kinetix 6000 drive system. For RBM installation instructions, refer to the Resistive Brake Module Installation Instructions, publication 2090-IN009.

IMPORTANT Drive firmware v1.071 or later is required to use the RBM with the Kinetix 6000 drives.

Understanding Safety Precautions

The following precautions apply to resistive brake module (RBM) installations as shown in the interconnect diagrams. Be sure to read and thoroughly understand them before proceeding.

ATTENTION

The interconnection diagrams should be used as a general recommendation on how the safety control circuit may be implemented. Actual applications may vary due to requirements based on the machine builders risk assessment. The machine builder must perform a risk assessment and determine a category level of safety that must be applied to the machine.

Safety Standards for Reference

- EN 1050 Safety of Machinery - Principles for Risk Assessment
- EN 60204-1 Safety of Machinery - Electrical Equipment of Machines
- EN 292-1/2 Safety of Machinery - Basic Concepts, General Principles for Design
- EN 954-1 Safety of Machinery - Safety Related Parts of Control Systems
- NFPA 79 Electrical Standard for Industrial Machinery
- ANSI B11.TR3 Risk Assessment and Risk Reduction. A guide to estimate, evaluate, and reduce risks associated with machine tools.

Background on Safety Design

There are numerous safety standards regarding machine design including OSHA, NFPA, AMT, CENELEC and ISO. In Europe, CENELEC and ISO coordinate the development of standards to which products can satisfy the laws of the Machinery Directive. In the United States, Standard Development Organizations (SDO) like the NFPA and AMT sponsor the development of standards to help companies meet OSHA requirements.

Stop Categories

One of the most basic safety functions is stopping the machine. The stopping function of a machine must fall into one of three categories (EN60204-1 and NFPA79). The categories are as follows:

- **Stop Category 0**: Stopping by immediate removal of power to the machine actuators.
- **Stop Category 1**: A controlled stop with power to the machine actuators to achieve the stop and then removal of power when the stop is achieved.
- **Stop Category 2**: A controlled stop with power left available to the machine actuators.

E-Stops are a special case of stops, and have additional requirements to those stated above. This appendix is intended to show how a light curtain or gate interlock might interface with one axis of motion control to achieve a machine stop and this stop may not be the same as the E-stop function of a machine.

Risk Assessment

The European safety standard (EN 1050) and U.S. technical report (ANSI B11.TR3) explain the process of risk assessment, which must be conducted by the machine builder. This is done by analyzing the tasks that people perform on and around the machine. This includes functions such as operation, set up, and maintenance. For the purpose of this appendix, the light curtain or gate interlock is intended to focus on the operation and perhaps loading/unloading of a machine. Additional protective measures must be identified by the risk assessment.

Machinery Directive EN 954-1 Safety Related Parts of Control Systems defines how to determine the safety requirements by categorizing the risk. This standard outlines the design of fail-safe control circuits by categorizing five levels of risk. It is deemed the machine designers responsibility to objectively identify a risk level for a particular machine and design all safety related systems to that level. The five categories are as follows:

Category B: Safety devices and control systems, as a minimum, must be designed, selected, and assembled to meet the operational requirements of design limits and influence of the processed materials and other external influences listed as: effects of vibration, loss of power supply, and external fields.

Category 1: All conditions of Category B apply, but the safety related part of the control system must use well tried principles and components (refer to 7.2.2: prEN951-1). The use of single electronic components, electronic logic or software is not considered adequate, even at this level.

Category 2: All conditions of Category B apply, but in addition, the machine shall be prevented from starting if a fault is detected upon power up. This suggests the use of an interface relay with redundancy and self-checking on energization. Single channel operation is permitted providing that the input devices (E-Stop buttons, gate switches, etc.) are tested for operation on a regular basis. If regular testing cannot be guaranteed, then the designer has little choice but to opt for two channel control.

Category 3: All conditions of Category B apply, but the complete safety control system shall be designed so that any single fault shall not lead to the loss of the safety function and, where practical, the single fault shall be detected. This now calls for not only redundancy in the interface relay but also in the input devices pointing to dual channel systems.

Category 4: All the conditions of Category B apply and, in addition, any single fault must be detected at or before the next call on the safety system, or an accumulation of three faults shall not lead to the loss of the safety function.

Control Reliability

In the United States the AMT has promoted a concept called Control Reliability as part of the ANSI B11.TR3 standard. This standard has similar requirements to those in the Machinery Directive EN954-1 Category 3 risk standard.

Control Reliability is defined as the ability of a safety system to go into a safe state in the event of a failure. In other words, the safety system must bring the machine to a safe state in the event of a single fault.

Resistive Brake Module Wiring Examples

This section provides interconnect diagrams to assist you in wiring a Kinetix 6000 system which includes an RBM. The notes in the table below apply to the following RBM interconnect example diagrams.

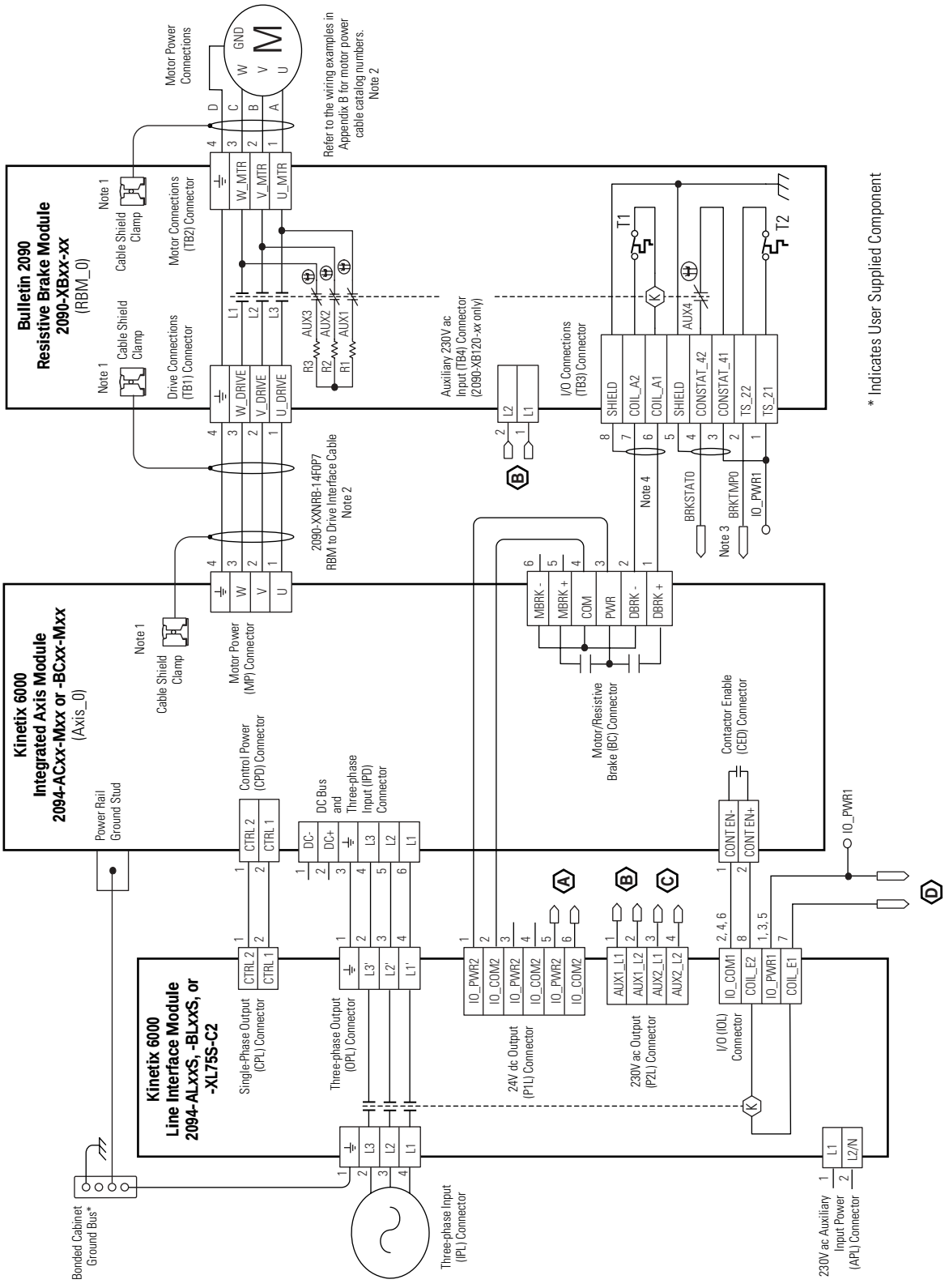
ATTENTION

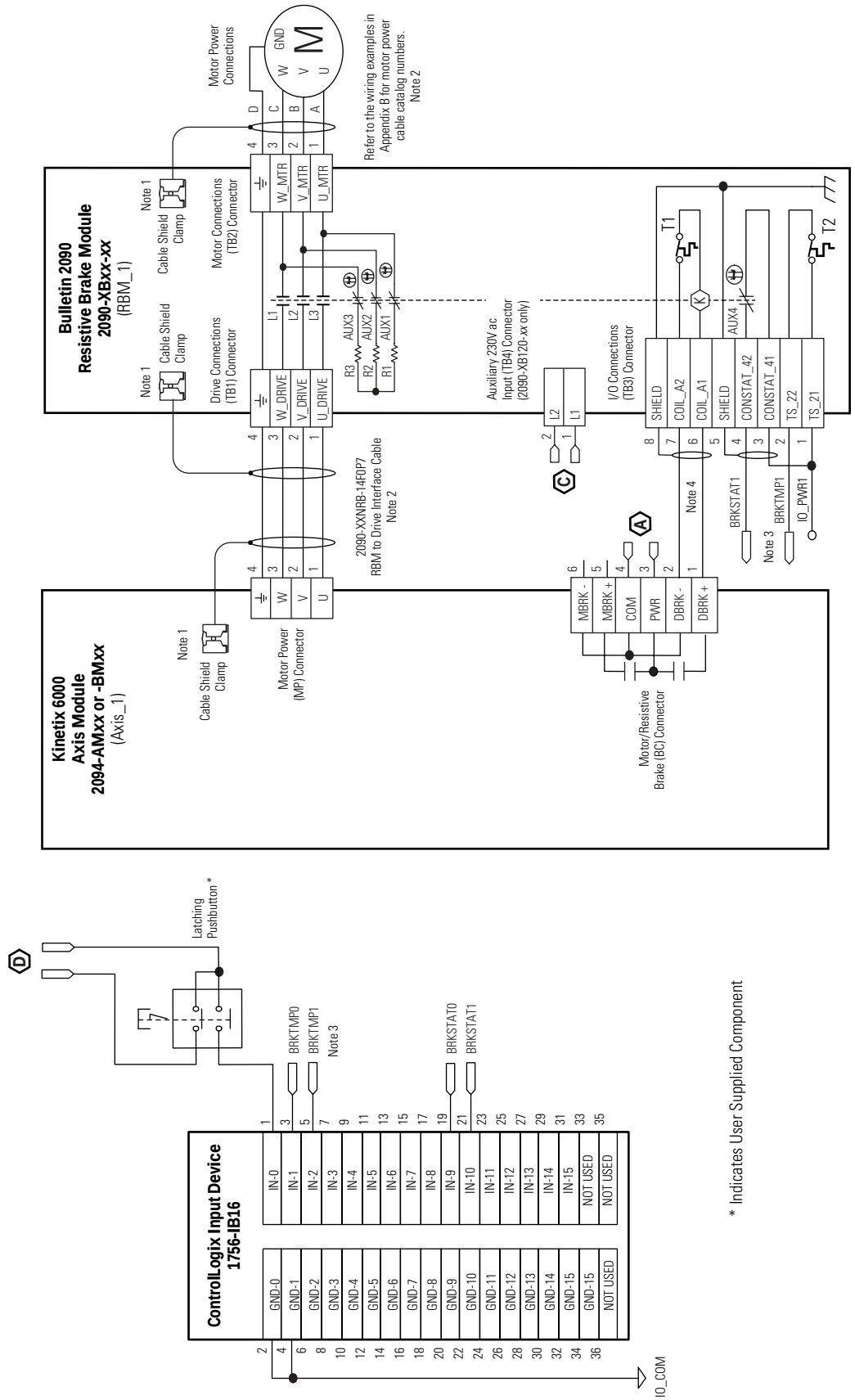
The National Electrical Code and local electrical codes take precedence over the values and methods provided. Implementation of these codes is the responsibility of the machine builder.

Note	Information
1	Cable shield clamp must be used in order to meet CE requirements. No external connection to ground required.
2	For motor cable specifications, refer to the Kinetix Motion Control Selection Guide, publication GMC-SG001.
3	The BRKTMP0 signal can be wired to a ControlLogix input as overtemp warning in user program.
4	Firmware version 1.071 or later is required to use the DBRK outputs on the Kinetix 6000 IAM or AM.
5	The safety relay time delay should be set beyond the time required to stop and disable the axis when running at full speed.
6	Drive Enable Input Checking must be selected when configuring Axis Properties in RSLogix 5000 software.

The example diagram below shows Kinetix 6000 IAM, AM, and LIM (2094-AL*xx*S, -BL*xx*S, and -XL75S) wired with the Bulletin 2090 RBM in a category 2 configuration.

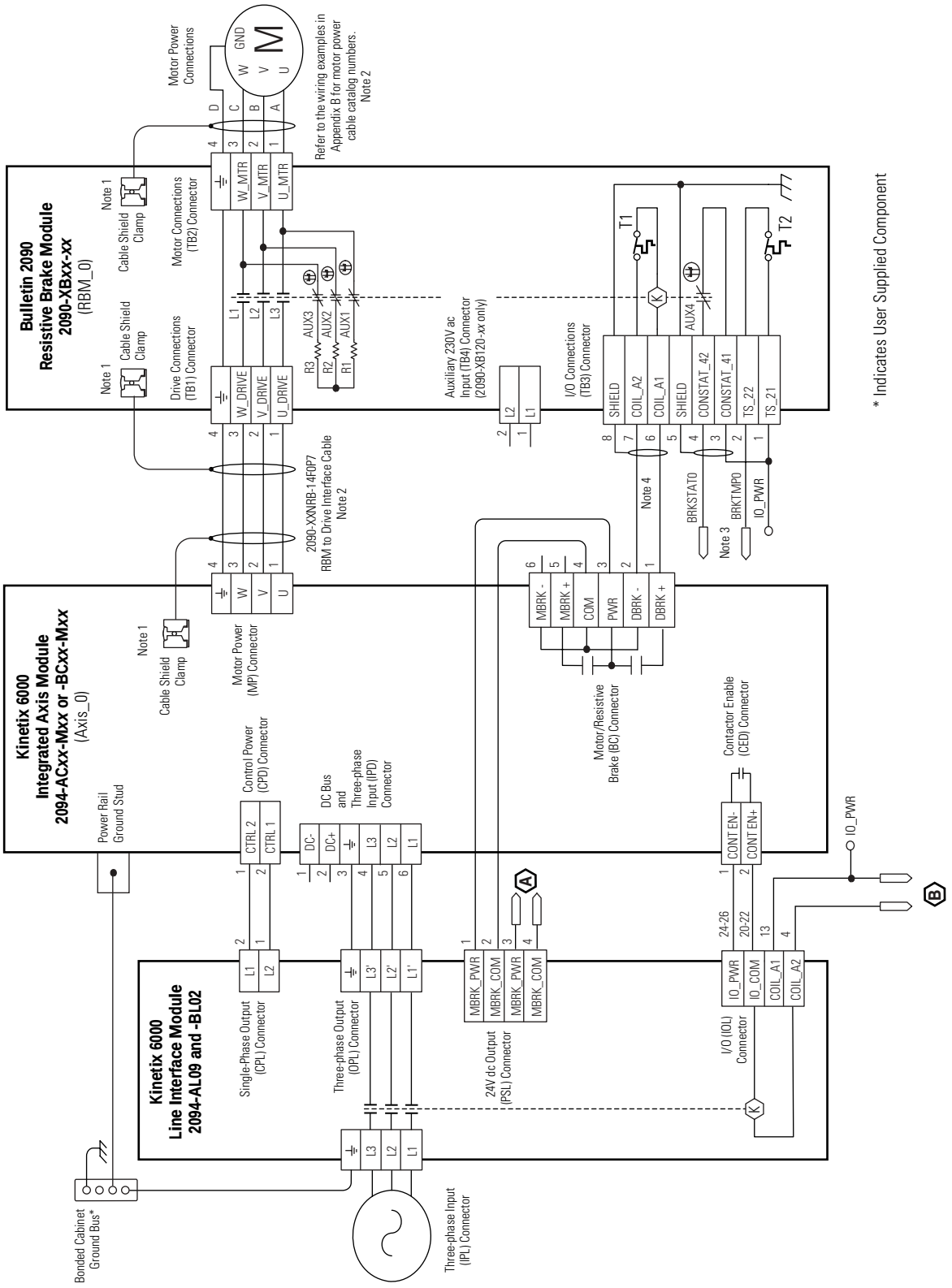
RBM Wiring Example (Category 2 Configuration per EN954-1)

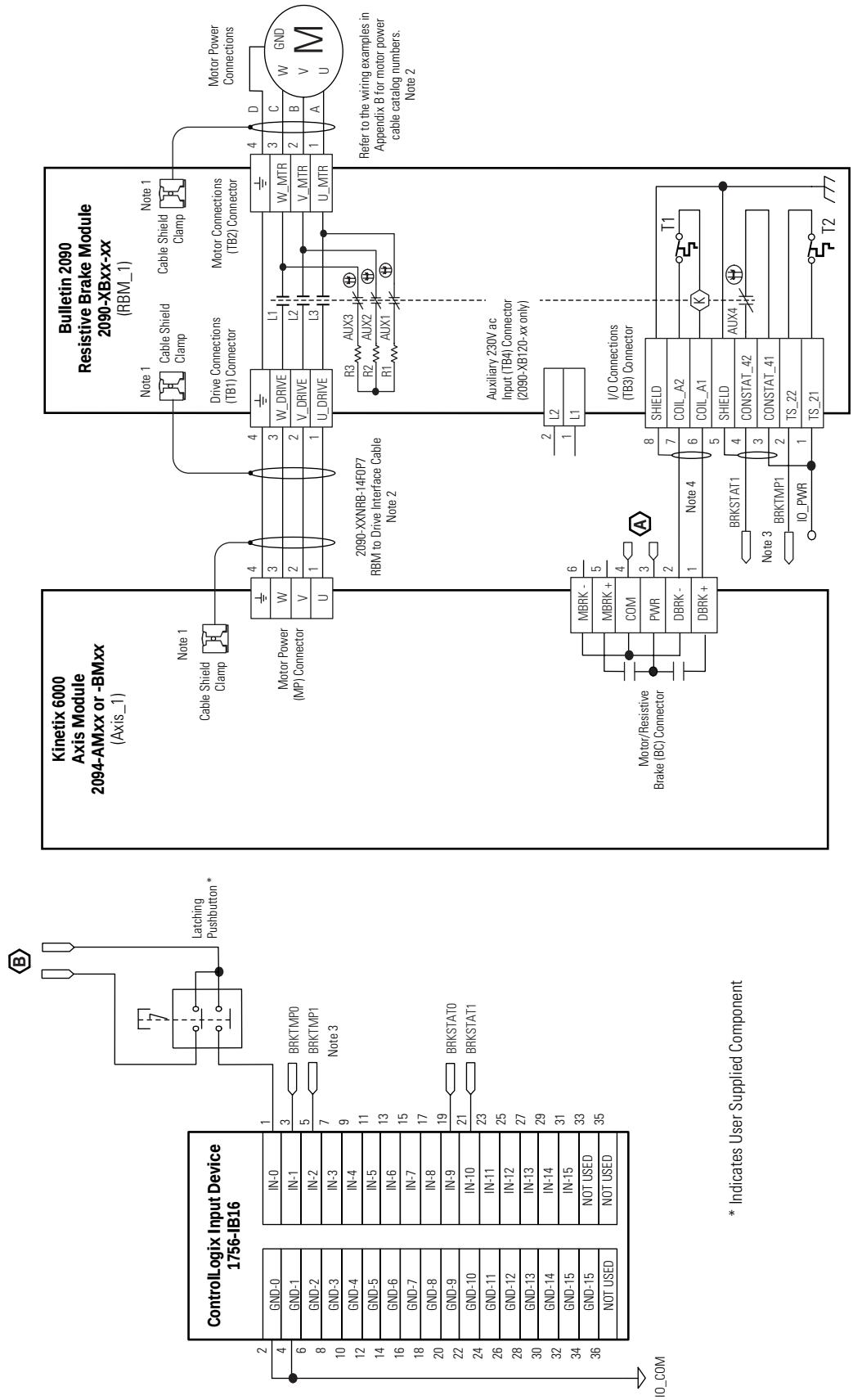



Bulletin 2090
Resistive Brake Module
2090-XBxx-xx
(RBM_1)
Kinetix 6000
Axis Module
2094-AMxx or -BMxx
(Axis_1)
Motor Power Connections
Refer to the wiring examples in Appendix B for motor power cable catalog numbers. Note 2
Motor Connections (TB2) Connector
Drive Connections (TB1) Connector
Auxiliary 230V ac Input (TB4) Connector (2090-XB120-xx only)
I/O Connections (TB3) Connector
2090-XXNRB-14F0P7 RBM to Drive Interface Cable Note 2
Motor Power (MP) Connector
Motor/Resistive Brake (BC) Connector
Cable Shield Clamp
Note 1
Note 3
Note 4
ControlLogix Input Device
1756-IB16
Latching Pushbutton *
BRKTMP0
BRKTMP1
BRKSTAT0
BRKSTAT1
IO_COM
* Indicates User Supplied Component

The example diagram below shows Kinetix 6000 IAM, AM, and LIM (2094-AL09 and -BL02) wired with the Bulletin 2090 RBM in a category 2 configuration.

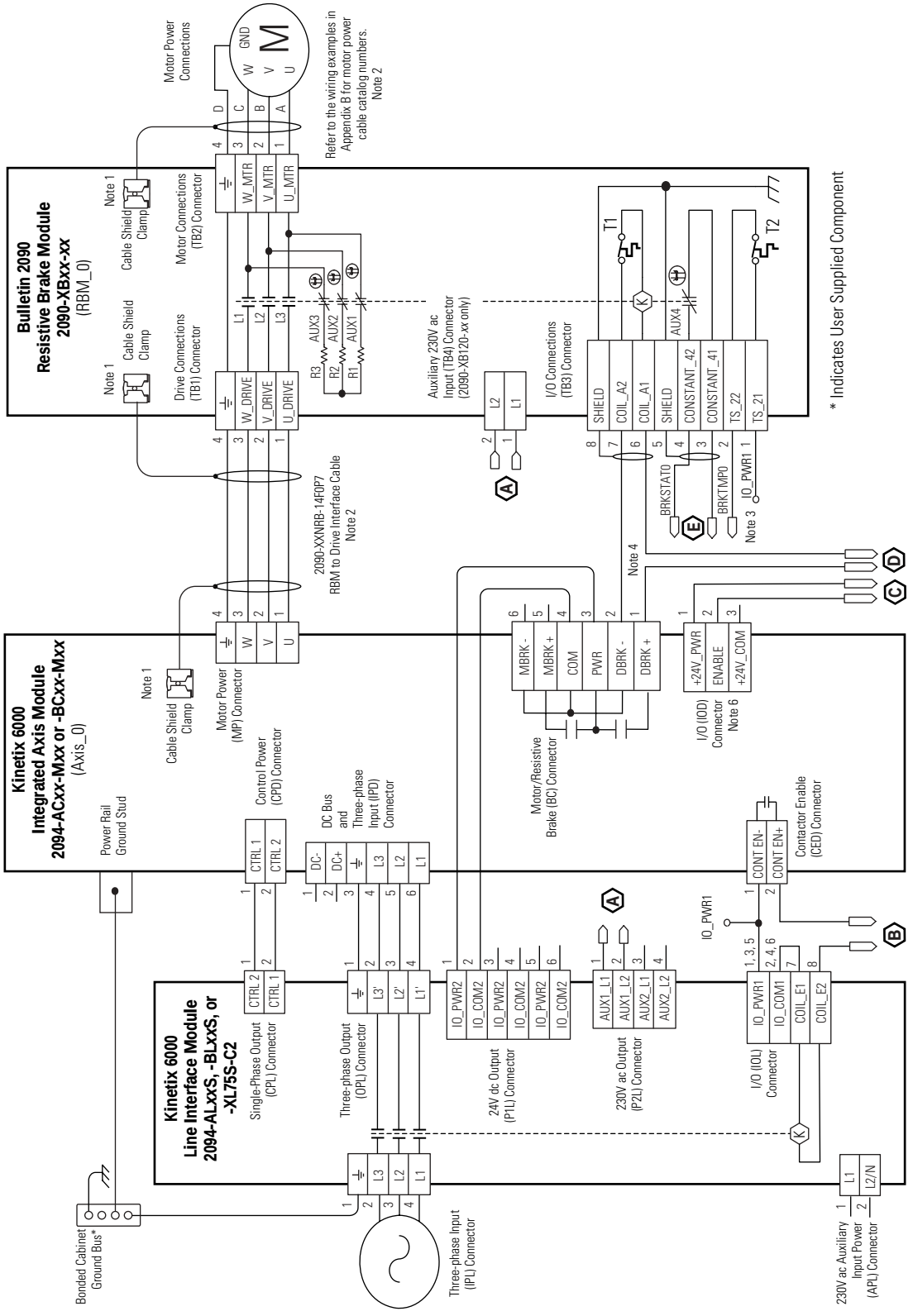
RBM Wiring Example (Category 2 Configuration per EN954-1)

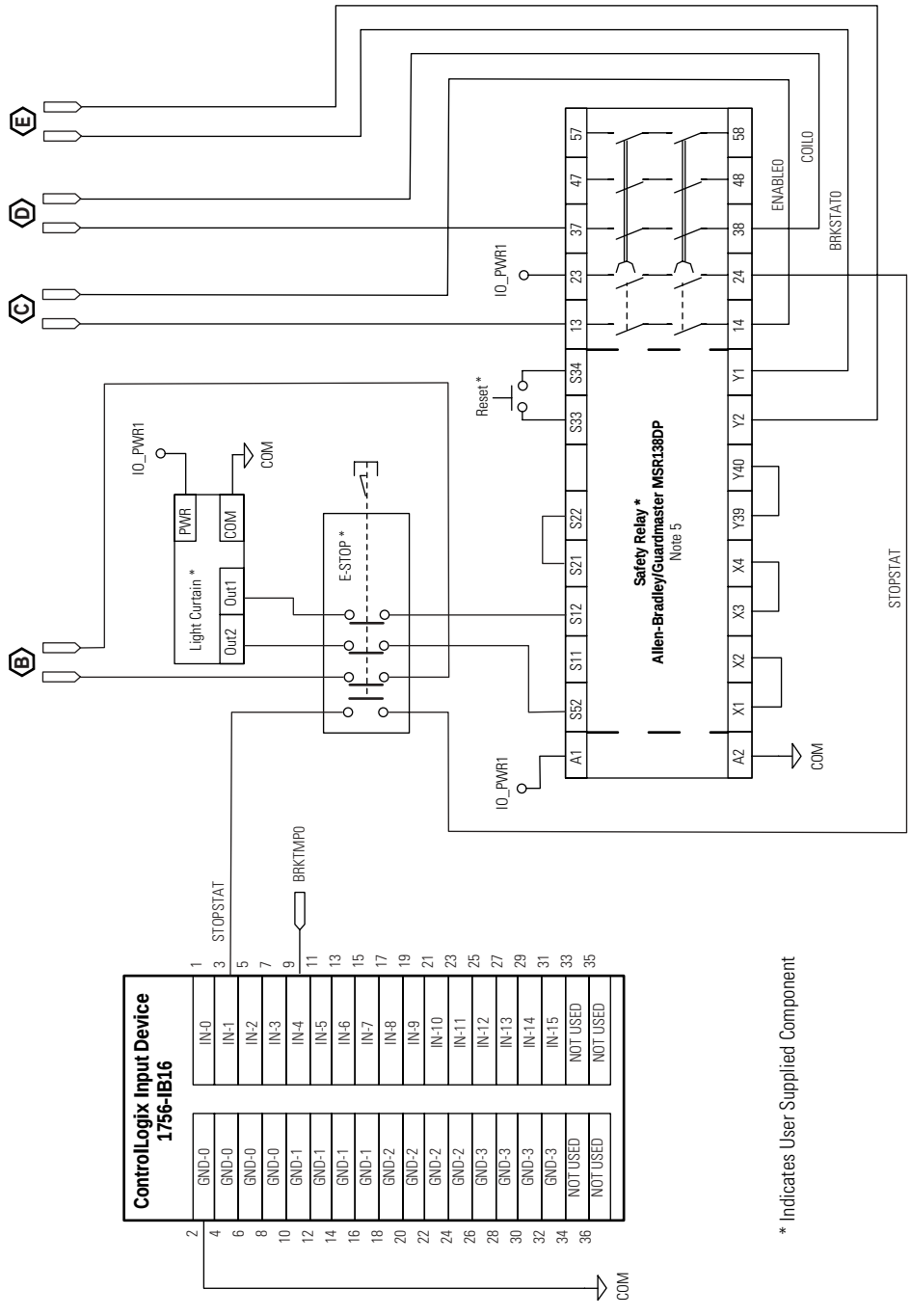



Bulletin 2090
Resistive Brake Module
2090-XBxx-xx
(RBM_1)
Kinetix 6000
Axis Module
2094-AMxx or -BMxx
(Axis_1)
Motor Power Connections
Refer to the wiring examples in Appendix B for motor power cable catalog numbers. Note 2
Motor Connections (TB2) Connector
Drive Connections (TB1) Connector
Auxiliary 230V ac Input (TB4) Connector (2090-XB120-xx only)
I/O Connections (TB3) Connector
2090-XXNRB-14F0P7 RBM to Drive Interface Cable Note 2
Motor Power (MP) Connector
Motor/Resistive Brake (BC) Connector
Cable Shield Clamp
Note 1
Note 3
Note 4
ControlLogix Input Device
1756-IB16
Latching Pushbutton *
BRKTMP0
BRKTMP1
BRKSTAT0
BRKSTAT1
IO_COM
* Indicates User Supplied Component

The example diagram below shows Kinetix 6000 IAM and LIM (2094-AL*xx*S, -BL*xx*S, and -XL75S) wired with the Bulletin 2090 RBM in a category 3 configuration.

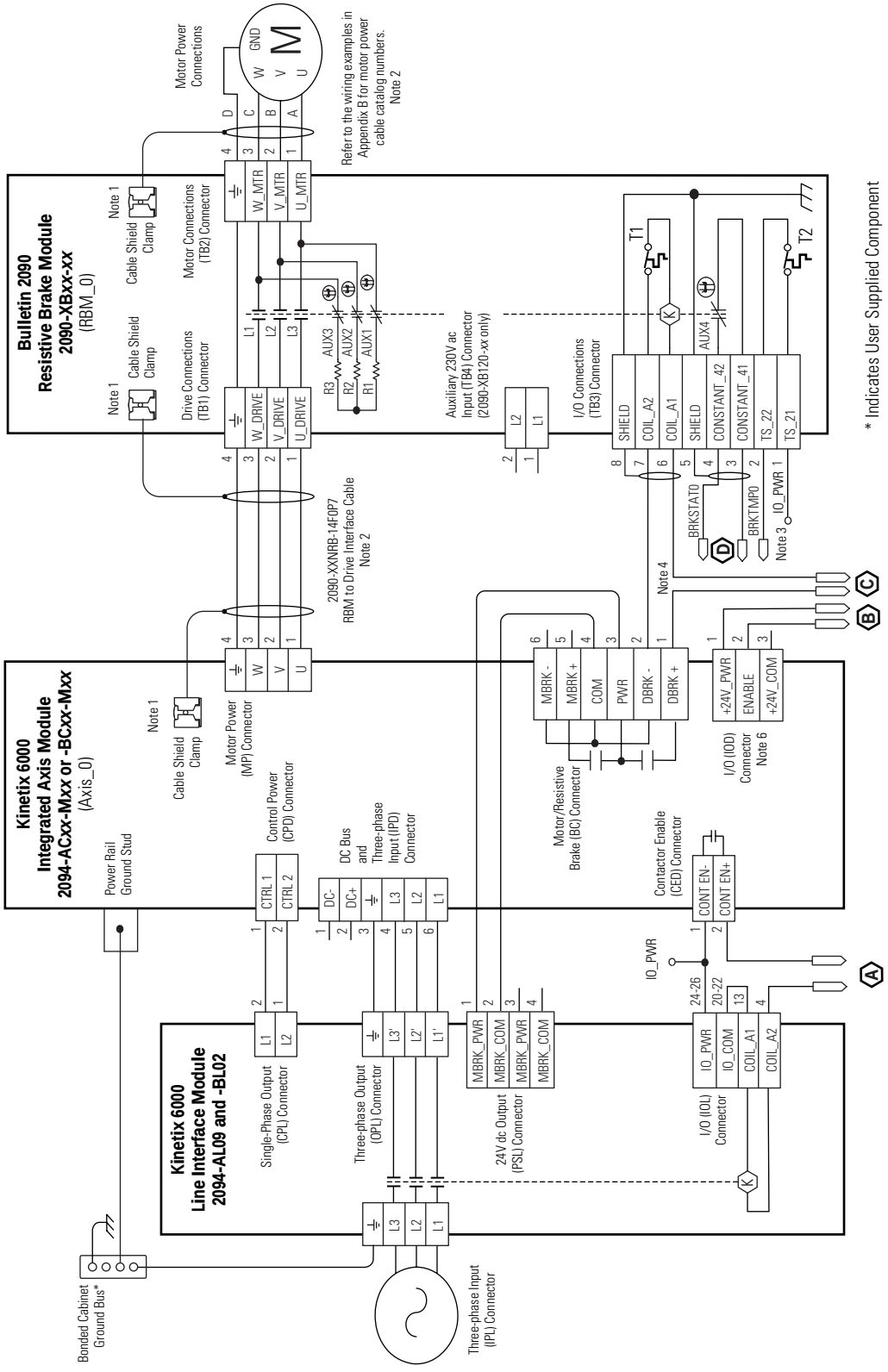
RBM Wiring Example (Category 3 Configuration per EN954-1)

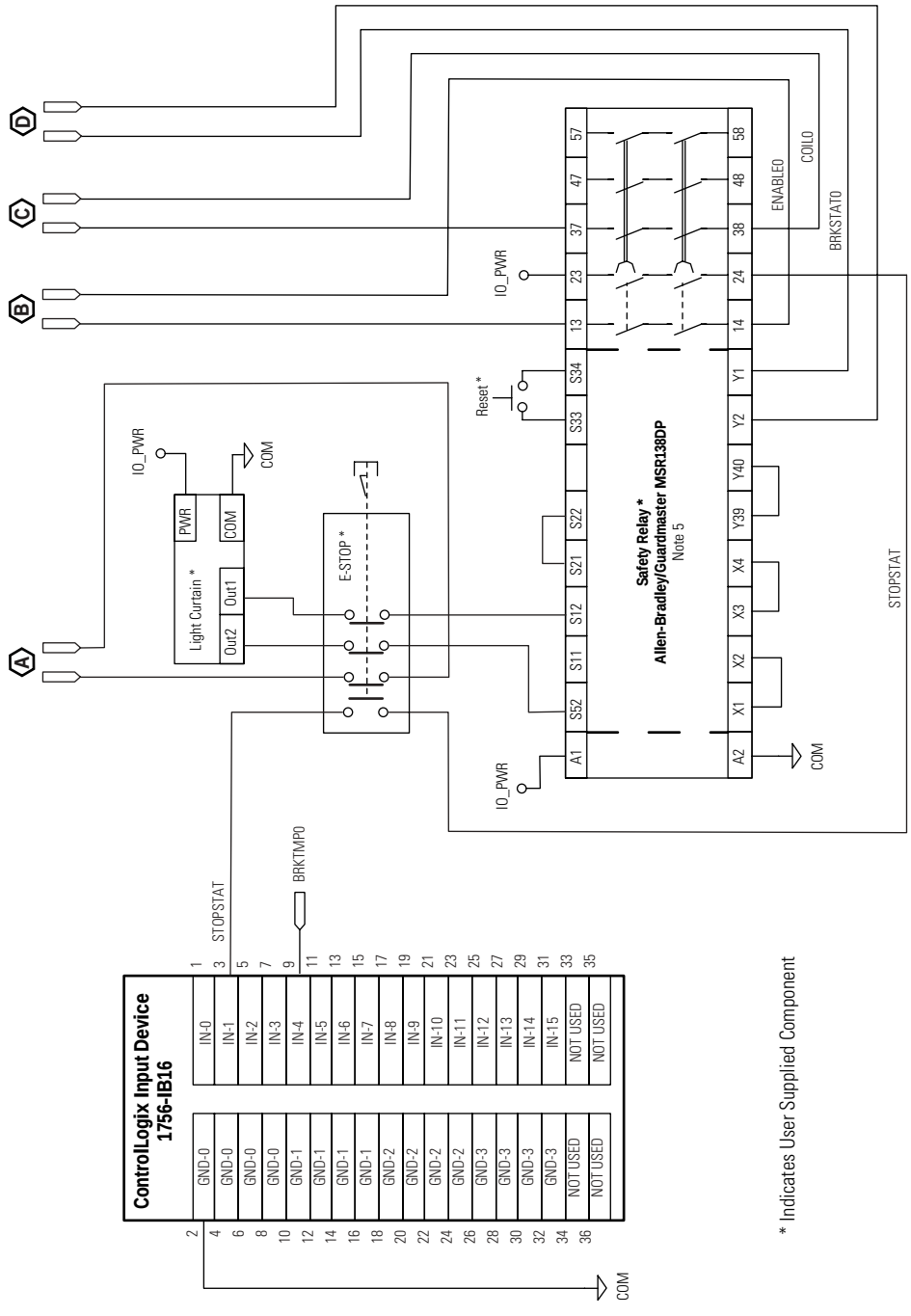



E
D
C
B
IO_PWR1
Reset *
Safety Relay *
Allen-Bradley/Guardmaster MSR138DP
Note 5
ENABLED
COILO
BRKSTATO
STOPSTAT
COM
Light Curtain *
PWR
Out1
Out2
COM
E-STOP *
ControlLogix Input Device
1756-IB16
IN-0
IN-1
IN-2
IN-3
IN-4
IN-5
IN-6
IN-7
IN-8
IN-9
IN-10
IN-11
IN-12
IN-13
IN-14
IN-15
NOT USED
GND-0
GND-1
GND-2
GND-3
BRKTMP0
* Indicates User Supplied Component

The example diagram below shows Kinetix 6000 IAM and LIM (2094-AL09 and -BL02) wired with the Bulletin 2090 RBM in a category 3 configuration.

RBM Wiring Example (Category 3 Configuration per EN954-1)




ControlLogix Input Device
1756-IB16
GND-0
IN-0
IN-1
IN-2
IN-3
IN-4
IN-5
IN-6
IN-7
IN-8
IN-9
IN-10
IN-11
IN-12
IN-13
IN-14
IN-15
NOT USED
NOT USED
STOPSTAT
BRKTMP0
COM
Safety Relay *
Allen-Bradley/Guardmaster MSR138DP
Note 5
A1
A2
S52
S11
S12
S21
S22
S33
S34
13
23
37
47
57
14
24
38
48
58
X1
X2
X3
X4
Y39
Y40
Y1
Y2
IO_PWR
COM
Reset *
E-STOP *
Light Curtain *
PWR
COM
Out1
Out2
ENABLED
COILO
BRKSTAT0
STOPSTAT
A
B
C
D
* Indicates User Supplied Component

Setting the RBM Delay Time Using DriveExplorer

In this procedure you will break SERCOS ring communications, set the delay time parameter using DriveExplorer software, and re-establish SERCOS communication.

For This Revision of RSLogix 5000 Software	Do This
v11 or v12	Proceed with these instructions using DriveExplorer to set the RBM delay time parameter.
v13 or later	Go to Configure Axis Properties on page 133 and use RSLogix 5000 software to set the RBM delay time parameter.

The following hardware and software tools are required to provide the necessary communication link between your personal computer and the Kinetix 6000 drive system running RSLogix 5000 software.

Description	Catalog Numbers	Version
DriveExplorer Software (1) (2)	9306-4EXP02ENE	2.01 or later
Serial to SCANport Adapter (2) (3)	1203-SSS (Series B)	3.004 or later
RSLogix 5000 Software	9324-RLD300NE	11.0 or 12.0
Personal computer with HyperTerminal	N/A	N/A

(1) Refer to DriveExplorer Getting Results Manual, publication 9306-GR001, for instructions.

(2) Additional information regarding these communication and software tools is available at http://www.ab.com/support/abdrives.

(3) Refer to 1203-SSS (Series B) FRN 3.*xxx* User Manual, publication 20COMM-UM001, for instructions.

ATTENTION

To avoid personal injury or equipment damage, at least one end of a SERCOS fiber-optic cable must be disconnected from the drive. This ensures that motion will not occur while changes are being made to the time delay parameter.

Removing SERCOS Communication

Follow these steps to remove (break) SERCOS communications.

1. Remove three-phase and control power from the Kinetix 6000 drive system.
2. Remove one of the SERCOS fiber-optic cables.

   Fiber-optic cable connections (Tx and Rx) are located on the top of each IAM/AM.
3. Re-apply three-phase and control power.

Setting the RBM Delay Time Parameter

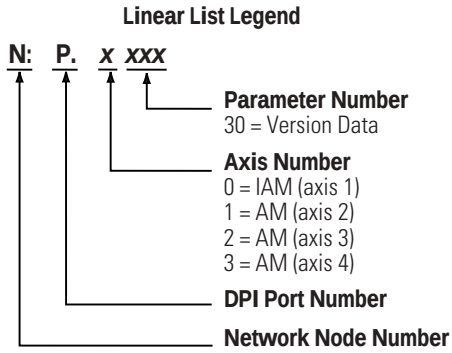
Follow these steps to set the RBM delay time parameter.

1. Start your DriveExplorer software.

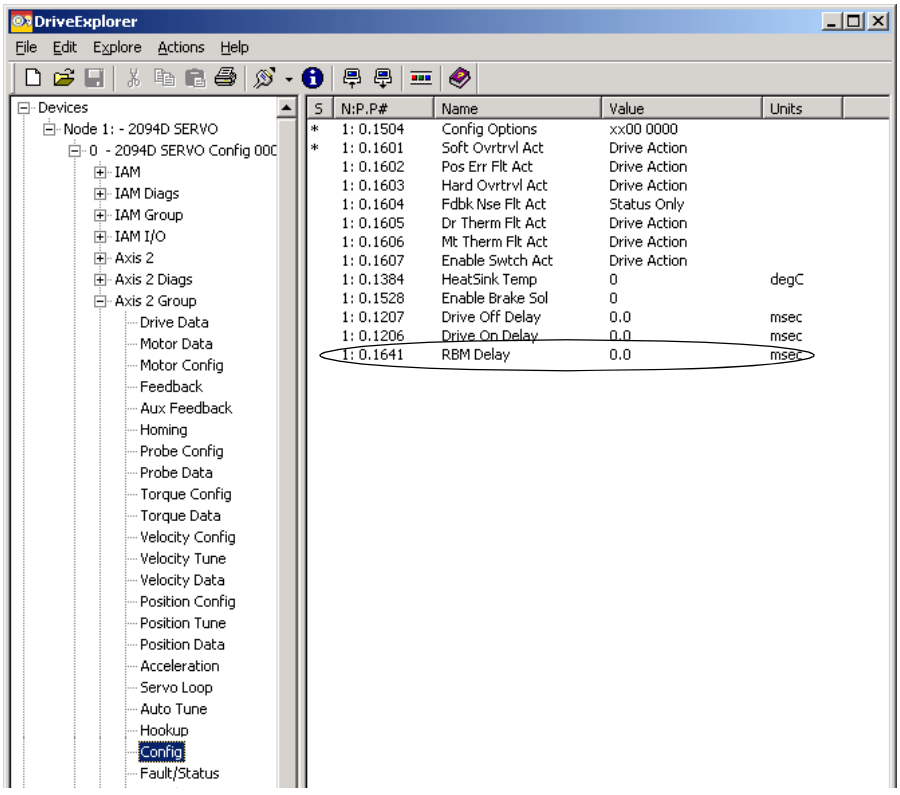
2. From the menu bar choose Explore\Connect\Local or enter Ctrl-L from the keyboard.

   DriveExplorer software will read your system.

3. Observe the Linear List of parameters as grouped by Node, Port, and Axis hierarchy as shown below.

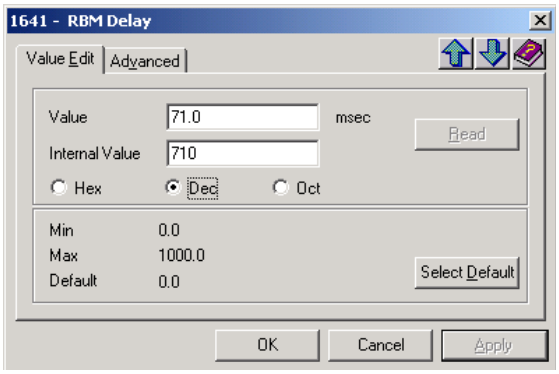


4. Select Devices\Node\Product\Axis *x* Group\Config and navigate to the Config parameters as shown below.



5. Double-click the *x:x:x*641 RBM Delay parameter.

   The command dialog for parameter *x*641 - RBM Delay opens.



6. Select the Value Edit tab and enter the delay time Value (ms).

   The recommended RBM delay time is 71 ms.

7. Click OK.

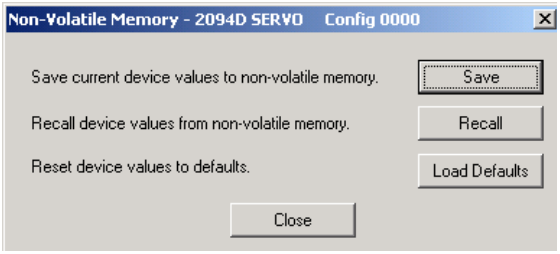
   The RBM delay time is changed, but not saved in non-volatile memory.

Saving the Delay Time Parameter to Non-Volatile Memory

Follow these steps to save the delay time parameter to non-volatile memory.

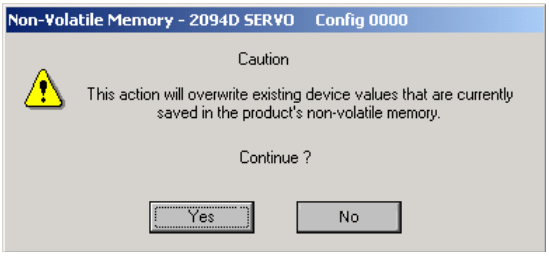
1. From the menu bar choose Actions\Non-Volatile Memory.

   The following message dialog opens.



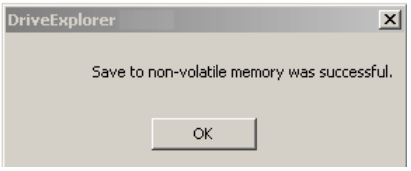
2. Click Save.

The changes are saved to non-volatile memory and the following cautionary message dialog opens.



3. Click Yes.

   The save to non-volatile memory is complete and the following confirmation message dialog opens.



4. Click OK.

5. Determine if you have another RBM to configure.

If you	Then
Have another RBM in the Kinetix 6000 system	Go to Setting the RBM Delay Time Parameter (Step 4).
Do not have another RBM in the Kinetix 6000 system	Close the DriveExplorer software. Go to Reconnecting SERCOS Communication.

Reconnecting SERCOS Communication

Follow these steps to reconnect SERCOS communication.

1. Remove three-phase and control power from the Kinetix 6000 drive system.

2. Replace the SERCOS fiber-optic cable removed earlier.

   Fiber-optic cable connections (Tx and Rx) are located on the top of each IAM/AM.

3. Re-apply three-phase and control power.

Numerics

A

B

C

D

E

F

G

H

I

K

L

M

N

O

P

R

S

T

U

W

X

Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products. At http://support.rockwellautomation.com, you can find technical manuals, a knowledge base of FAQs, technical and application notes, sample code and links to software service packs, and a MySupport feature that you can customize to make the best use of these tools.

For an additional level of technical phone support for installation, configuration, and troubleshooting, we offer TechConnect Support programs. For more information, contact your local distributor or Rockwell Automation representative, or visit http://support.rockwellautomation.com.

Installation Assistance

If you experience a problem with a hardware module within the first 24 hours of installation, please review the information that's contained in this manual. You can also contact a special Customer Support number for initial help in getting your module up and running.

United States	1.440.646.3223 Monday – Friday, 8am – 5pm EST
Outside United States	Please contact your local Rockwell Automation representative for any technical support issues.

New Product Satisfaction Return

Rockwell tests all of its products to ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning, it may need to be returned.

United States	Contact your distributor. You must provide a Customer Support case number (see phone number above to obtain one) to your distributor in order to complete the return process.
Outside United States	Please contact your local Rockwell Automation representative for return procedure.

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